



Project Manual

for

New CTE Center & Hargrave High School Additions & Renovations

PBK Project No.: 240157

for the

HUFFMAN INDEPENDENT SCHOOL DISTRICT

22 May 2025

Issue for Proposal



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Chief Officer of Finance
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Hargrave High School Principal
District Career and Technology Director
District Athletic Director



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Team

Architect

PBK
11 Greenway Plaza Blvd, 22nd Floor
Houston, Texas 77046
Phone: (713) 965-0608

MEPT

LEAF Engineers
11 Greenway Plaza, 15th Floor
Houston, Texas 77046
Phone: (713) 914-3300

Civil

Kimley Horn
11700 Katy Freeway, Ste. 800
Houston, Texas 77079
Phone: (281) 597-9300

Landscape

Edgeland Group
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Houston, Texas 77046
Phone: (713) 460-0988

Structure

Kubala Engineers
11 Greenway Plaza, Ste. 1510
Houston, Texas 77046
Phone: (713) 940-3343

Building Envelope

BEAM Professionals
11 Greenway Plaza, 15th Floor
Houston, Texas 77046
Phone: (713) 965-0608

Door Hardware



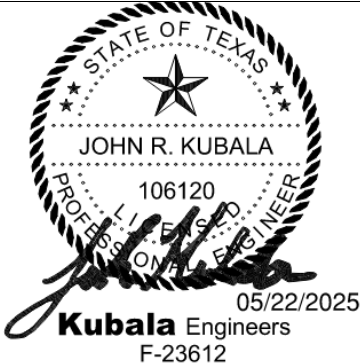
Assa Abloy
9001 Jameel Road, Ste.190
Houston, Texas 77040
Phone: (713) 934-9095



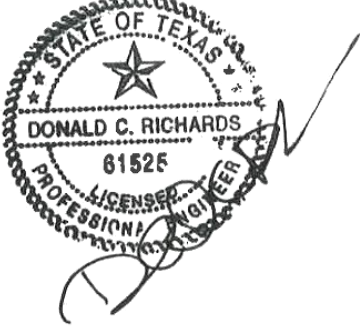


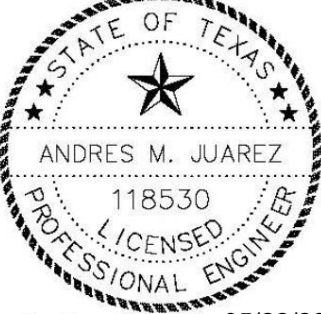
Food Service

Foodservice Design Professionals
25317 I-45
The Woodlands, Texas 77380
Phone: (281) 451-5917

Issue for Proposal

Each specification section included herein is listed in the Project Manual Table of Contents with a letter code, indicated below, designating the Designer of Record responsible for its preparation, under whose seal and/or authority it is issued for the purpose(s) stated above. Seals and signatures do not apply to documents not included herein, nor (except as otherwise indicated) to documents prepared by the Owner or others ("O"), including but not necessarily limited to documents in Division 00, geotechnical and other reports, etc.

<p>Architect of Record:</p> <p>Melissa A. Kapple</p> <p>R.A. # 30374</p>		<p>PBK 11 Greenway Plaza Blvd, 22nd Floor Houston, Texas 77046 Phone: (713) 965-0608</p>
<p>Architect of Record, Landscape:</p> <p>Jacob T. Galles</p> <p>R.A. # 3022</p>		<p>Edgeland Group 11 Greenway Plaza, 15th Floor Houston, Texas 77046 Phone: (713) 460-0988</p>
<p>Engineer of Record, Structural:</p> <p>John R. Kubala</p> <p>P.E. # 106120</p>		<p>Kubala Engineers 11 Greenway Plaza, Ste. 1510 Houston, Texas 77046 Phone: (713) 940-3343</p>

<p>Engineer of Record, Mechanical:</p> <p>Mital J. Patel</p> <p>P.E. # 111622</p>	 <p>May 22, 2025</p>  <p>F-18672</p>	<p>LEAF Engineers 11 Greenway Plaza, 15th Floor Houston, Texas 77046 Phone: (713) 940-3300</p>
<p>Engineer of Record, Electrical, Plumbing & Technology:</p> <p>Donald C. Richards</p> <p>P.E. # 61525</p>	 <p>May 22, 2025</p>  <p>F-18672</p>	<p>LEAF Engineers 11 Greenway Plaza, 15th Floor Houston, Texas 77046 Phone: (713) 940-3300</p>
<p>Engineer of Record, Civil:</p> <p>Kyle Molitor, P.E.</p> <p>P.E. # 126028</p>	 <p>05/22/2025</p>	<p>Kimley Horn 11700 Katy Freeway, Ste. 800 Houston, Texas 77079 Phone: (281) 597-9300</p>
<p>Engineer of Record, Civil: Fire Suppression System</p> <p>Andres M. Juarez, P.E.</p> <p>P.E. # 118530</p>	 <p>05/22/2025</p>	<p>DIG Engineers Texas Registered Engineering Firm F18326 11 Greenway Plaza, Ste. 1520 Houston, Texas 77046 Phone: 713-965-0608</p>

DIVISION 0 – PROCUREMENT AND CONTRACTING REQUIREMENTS

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	Attachment B – Non-Collusion Affidavit
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01 25 13.1	Request for Substitution
01 26 00	Contract Modification Procedures
01 29 00	Payment Procedures
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01 29 73.1	Schedule of Values – Sample
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PBK Architects
Project No. 240157

New CTE Center & Hargrave High School Additions & Renovations
Huffman Independent School District

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END OF DOCUMENT 00 00 10



REQUEST FOR COMPETITIVE SEALED PROPOSALS

NO. 04-2025

**HUFFMAN ISD NEW CTE CENTER & HARGRAVE HIGH SCHOOL
ADDITIONS & RENOVATIONS**

PROPOSALS ARE DUE: JUNE 19, 2025 AT 2:00 PM

**Huffman Independent School District
24302 FM 2100
Huffman, Texas 77336**

(281) 324-1871

HUFFMAN INDEPENDENT SCHOOL DISTRICT
REQUEST FOR COMPETITIVE SEALED PROPOSALS (“RFCSP”)

The Huffman Independent School District (“HISD” or “District”) is soliciting competitive sealed proposals for general construction services of a General Contractor the project(s) described on Attachment D (“the Project”) pursuant to Chapter 2269 of the Texas Government Code.

The RFCSP provides all information, Drawings and Specifications necessary to prepare and submit a sealed Proposal for consideration and ranking by the Owner. The Owner may select the Proposal that offers the “best value” for the District based on the published selection criteria and weight of criteria, and on its ranking evaluation. As indicated herein, factors other than price will be considered in making this determination. Upon approval of the rankings by the Board of Trustees, the District’s representative will attempt to negotiate a contract with the selected Proposer. If the prices proposed are more than the District’s budget for the Project, the Owner’s representative may discuss with the selected Proposer options for scope or time modifications and any price change associated with the modification. If the representative is unable to reach a contract with the selected Proposer, the representative may formally end negotiations with that Proposer and proceed to the next ranked Proposer in the order of the selection ranking until a contract is reached or all proposals are rejected.

DEADLINES AND SUBMISSIONS

Proposal Questionnaire – The proposal questionnaire responses are due no later than **2:00 PM on JUNE 17, 2025**. They are to be submitted to **Melissa Kapple** via email at **melissa.kapple@pbk.com**. Proposal Questionnaires shall be submitted in entirety as the answers and references will be used by the owner to complete the scoring matrix.

Proposal Attachments and Forms – Proposal attachments and forms are to include the information requested in the **PROPOSAL REQUIREMENTS** section, including all forms referenced in the sequence and format prescribed. Proposals will only be accepted electronically via the District’s purchasing site at <https://huffmanisd.ionwave.net>. Proposals are due no later than **2:00 PM on JUNE 19, 2025**. Proposals will be electronically opened and publicly read aloud at the District’s Administration Building, 24302 FM 2100, Huffman, TX 77336, immediately after the expiration of the above deadline. No proposal shall be accepted after this deadline.

Subcontractor Questionnaire – The subcontractor questionnaire is due no later than **2:00 PM on JUNE 20, 2025**. The subcontractor questionnaire is to be submitted to **Melissa Kapple** via email at **melissa.kapple@pbk.com** and will be used by the owner to complete the scoring matrix.

GENERAL INFORMATION

Information will be available through the e-bid system website at <https://huffmanisd.ionwave.net>.

Proposals are to be submitted online through the e-bid website <https://huffmanisd.ionwave.net>. Please upload a complete proposal.

Interested parties are encouraged to visit the District's purchasing site at the above-mentioned address and complete the supplier registration at their earliest convenience. Once supplier registration is completed, interested parties will have access to all relevant construction documents and will be notified of any addendums that are released.

Inquiries regarding this Request for Proposals, or requests for additional information, should be submitted to **Melissa Kapple** via email at melissa.kapple@pbk.com by **4:00 PM** on **JUNE 9, 2025**. Questions and answers will be posted to <https://huffmanisd.ionwave.net> via addendum.

Under no circumstance should the Huffman Independent School District, its staff, its employees, any member of the HISD Board of Trustees, or any other public official be contacted during the receipt of the RFCSP, and before the awarding of the contract, except Purchasing Office personnel. Violation of this requirement may result in the disqualification of your response from consideration.

SELECTION PROCESS

The District will evaluate the proposers on the basis of the selection criteria stated below. The District will base its selection on a point system to evaluate the proposals and will consider the following criteria:

PRICING	30 POINTS
GENERAL EXPERIENCE	20 POINTS
PROJECT APPROACH	15 POINTS
PROPOSED PERSONNEL	15 POINTS
SAFETY RECORD	5 POINTS
QUALITY ASSURANCE	5 POINTS
SUBCONTRACTORS	10 POINTS

PRICING: (30 POINTS)

The lowest price, including accepted alternates, will receive all 30 points and other proposals points will be awarded proportionally.

GENERAL EXPERIENCE: (20 POINTS)

Our evaluation will include an assessment of the history of your company, your experience as it relates to the requirements with this RFCSP, evidence of past performance, quality and relevance of past work, references, and related items.

PROJECT APPROACH: (15 POINTS)

Our evaluation will include an assessment of the contractor's ability to work with the project team, the ability to work embedded in an active school site and develop a plan to complete the project on time and in budget.

PROPOSED PERSONNEL: (15 POINTS)

Our evaluation will include an assessment of the proposed personnel including the project manager, the site superintendent and the successful projects they have completed together. Both will need to have a resume of successful installations similar in size and scope.

SAFETY RECORD: (5 POINTS)

Our evaluation will include an assessment of the proposer's safety record and safety program including the accident frequency rate and worker's compensation modification factor.

QUALITY ASSURANCE: (5 POINTS)

Our evaluation will include an assessment of the proposer's quality assurance program including methods of quality control, punch list management and rate of warranty call backs.

SUBCONTRACTORS: (10 POINTS)

Our evaluation will include an assessment of the proposer's identified subcontractors and their ability to complete the identified scope of work.

INSTRUCTIONS TO PROPOSERS:

A. PROPOSAL SUBMISSION: Please read through entire proposal and use the section titled "Proposal Requirements" as a checklist of submission items for this RFCSP. Please note there are three deliverables with three separate due dates, as defined below:

1. Proposal Questionnaire – Due June 17, 2025, at 2:00 PM via email to **Melissa Kapple** via email at **melissa.kapple@pbk.com**
2. Proposal Attachments – Due June 19, 2025, at 2:00 PM via <https://huffmanisd.ionwave.net>
3. Subcontractor Questionnaire – Due June 20, 2025, at 2:00 PM via email to **Melissa Kapple** via email at **melissa.kapple@pbk.com**

B. BID BOND: The Proposer shall submit a competitive sealed proposal that includes:

1. A Bid Bond payable to the Huffman ISD, for no less than 5% of the largest possible total (include the cost of alternates listed) for the proposal listed.

C. AGREEMENT: The Agreement between the Owner and Contractor shall consist of the following:

1. Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, AIA Document A101-2017, as modified by the Owner (attached as Attachment C).
2. General Conditions of the Contract for Construction, AIA Document A201-2017, as modified by the Owner (attached as Attachment C).

By submitting a response to this RFCSP, the proposer agrees to the terms and conditions contained in the A101 and A201, as modified by Owner, and agrees to execute a final version of these contracts

subject to approval by Owner. **Proposer must state any requested modifications and an explanation for such modifications to these Contract Documents as part of its response to this Request. These will be considered by the Owner at the point of contract negotiations. If no requests are made and/or explanations provided in the proposer's response, the proposer will be deemed to agree to execute the Contract Documents without modification and no modifications shall be considered by HISD.**

3. Performance and Payment Bonds for one hundred percent (100%) of the construction cost will be required prior to beginning the work.
 4. Each project will include a liquidated damages provision providing for liquidated damages for each calendar day of delay until the Work is substantially complete in the amount provided in Attachment C (Section 1.7).
 5. Each project shall have umbrella or excess liability insurance in the amount provided in Attachment C (Section 1.8).
- D. TIME:** Proposer agrees to hold the proposal open for acceptance for thirty (30) calendar days from the proposal date.
- E. WITHDRAWAL OF PROPOSALS:** Proposers may request permission to withdraw a proposal prior to the actual time for proposal opening. Such request must be made in person, in writing at the District's Administration Building, 24302 FM 2100, Huffman, TX 77336. HISD will return the proposal documents unopened at that time.
- F. WAIVER:** By submitting a proposal, each proposer agrees to waive any claim it has or may have against HISD, its trustees, agents and employees, and any reference sources, arising out of or in connection with the administration, evaluation, or recommendation of any proposal; waiver of any requirements under the proposal documents; acceptance or rejection of any proposal; and award of the proposal. HISD shall have no contractual obligation to any proposer, nor will any proposer have any property interest or other right in the proposal or contract being proposed unless and until the contract is unconditionally executed and delivered by all parties, and all conditions to be fulfilled by the proposer have been fulfilled by the proposer.
- G. MINIMUM WAGE RATES:** Successful proposers shall pay at least the minimum wage rate set forth in the Prevailing Wage Rate Schedule ascertained and adopted by the Board of Trustees to all employees and subcontractors performing work on this project and in no event shall the successful proposer pay less than the rate adopted. See the Prevailing Wage Rate Schedule, shown below, labeled Exhibit 1.

Exhibit 1: Prevailing Wage Rate Provisions



Harris County Building Construction Prevailing Wage Rates Quarter 2 of 2025



Worker Classifications		Base Rate	Fringe Benefit	Wage Total
Asbestos Worker/Heat and Frost Insulator (Duct, Pipe and Mechanical System Insulation)	1 Journeyman / 1 Apprentice	\$28.35	\$16.02	\$44.37
Acoustical Ceiling Mechanic		\$17.27	\$3.98	\$21.25
Boilermaker	5 Journeyman / 1 Apprentice	\$33.17	\$24.92	\$58.09
Bricklayer	1 Journeyman / 3 Mason Tenders Brick	\$18.87	\$0.00	\$18.87
Carpenter (Excludes Acoustical Ceiling Installation, Drywall Hanging, Form Work and Metal Stud Installation)	2 Journeyman / 1 Apprentice	\$25.86	\$9.08	\$34.94
Caulker		\$15.36	\$0.00	\$15.36
Cement Mason/Concrete Finisher	1 Journeyman/ 3 Mason Tenders Cement	\$15.00	\$0.00	\$15.00
Drywall Finisher/Taper	1 Journeyman/ 3 Helpers \$15.00	\$16.27	\$3.66	\$19.93
Drywall Hanger (includes Metal Studs Installer)	1 Journeyman/ 3 Helpers \$15.00	\$17.44	\$3.93	\$21.37
Electrician (Excludes Low Voltage Wiring and Installation of Alarms)	3 Journeyman / 2 Apprentice	\$34.50	\$10.41	\$44.91
Electrician (Alarm Installation Only)- APPRENTICES (see definitions)-Electrician (Alarm Installation Only) - 1 Journeyman/1 Apprentice APPRENTICES (see definitions)	1 Journeyman/1 Apprentice	\$17.97	\$3.37	\$21.34
Electrician (Low Voltage Wiring Only)-HELPER (see definitions)	1 Journeyman/3 Helper \$15.00	\$18.00	\$1.68	\$19.68
Elevator Mechanic	1 Journeyman / 1 Apprentice	\$53.59	\$38.44	\$92.03
Floor Layer/Carpet Layer-Floor Layer/Carpet Layer - 1 Journeyman / 3 Helpers \$15.00	1 Journeyman / 3 Helpers \$15.00	\$20.00	\$0.00	\$20.00
Form Builder/Formsetter	1 Journeyman/ 3 Helpers \$15.00	\$15.00	\$0.00	\$15.00
Glazier	1 Journeyman/ 3 Helpers \$15.00	\$23.27	\$7.12	\$30.39
Insulator (Batt and Foam)	1 Journeyman/ 3 Helpers \$15.00	\$15.00	\$0.73	\$15.73
Ironworker - Reinforcing	1 Journeyman/ 3 Helpers \$15.00	\$15.00	\$0.00	\$15.00
Ironworker - Structural -Ironworker - Structural - 1 Journeyman/ 3 Helpers \$15.00	1 Journeyman/ 3 Helpers \$15.00	\$28.26	\$8.13	\$36.39
Ironworker- Ornamental-Ironworker- Ornamental - 1 Journeyman/ 3 Helpers \$15.00	1 Journeyman/ 3 Helpers \$15.00	\$28.26	\$8.13	\$36.39
Laborer-Common Laborer-Common Laborer - Laborer -		\$15.00	\$0.00	\$15.00
Laborer- Landscape and Irrigation		\$15.00	\$0.00	\$15.00
Laborer- Mason Tender Brick (Bricklayer's Helper)		\$15.00	\$0.00	\$15.00
Laborer-Mason Tender Cement- (Concrete Mason's / Concrete Finisher's Helper)		\$15.00	\$0.00	\$15.00
Laborer-Pipelayer		\$15.00	\$0.00	\$15.00
Laborer- Roof Tearoff		\$15.00	\$0.00	\$15.00
Lather	1 Journeyman/ 3 Helpers \$15.00	\$19.73	\$0.00	\$19.73
Operator- Backhoe, Excavator, Trackhoe		\$15.00	\$0.00	\$15.00
Operator- Bobcat/Skid, Steer/Skid Loader		\$15.00	\$0.00	\$15.00
Operator- Bulldozer		\$22.75	\$0.00	\$22.75
Operator- Crane		\$39.47	\$10.39	\$49.86
Operator- Drill		\$16.22	\$0.34	\$16.56
Operator- Forklift		\$16.00	\$0.00	\$16.00
Operator- Grader/Blade		\$15.00	\$0.00	\$15.00
Operator- Loader		\$15.00	\$0.94	\$15.94
Operator- Mechanic		\$17.52	\$3.33	\$20.85
Operator- Paver (Asphalt, Aggregate, and Concrete)		\$16.03	\$0.00	\$16.03
Operator- Roller		\$16.00	\$0.00	\$16.00
Painter (Brush, Roll, Spray)	1 Journeyman/ 3 Helpers \$15.00	\$17.24	\$4.41	\$21.65
Pipefitters (Includes HVAC Pipe Installation)	1 Journeyman/ 1 Apprentice	\$41.14	\$11.86	\$53.00
Plasterer	1 Journeyman / 3 Plaster Tenders	\$31.34	\$10.30	\$41.64
Plumbers (Excludes HVAC Installation)	3 Journeyman / 2 Apprentice	\$39.98	\$11.61	\$51.59

Roofer	1 Journeyman/ 3 Helpers \$15.00	\$15.40	\$0.00	\$15.40
Sheet Metal Worker (Excludes HVAC Duct and System Installation)	2 Journeyman/ 1 Apprentice	\$29.70	\$13.85	\$43.55
Sheet Metal Worker (HVAC Duct Installation Only)	2 Journeyman/ 1 Apprentice	\$29.70	\$13.85	\$43.55
Sheet Metal Worker (HVAC Unit Installation Only)	2 Journeyman/ 1 Apprentice	\$20.05	\$2.24	\$22.29
Sprinkler Fitter (Fire Sprinklers)	1 Journeyman/ 1 Apprentice	\$36.15	\$24.47	\$60.62
Tile Finisher	1 Journeyman/ 3 Helpers \$15.00	\$15.00	\$0.00	\$15.00
Tile Setter	1 Journeyman/ 3 Helpers \$15.00	\$16.17	\$0.00	\$16.17
Truck Driver- 1 Single Axle Truck		\$15.00	\$0.00	\$15.00
Truck Driver- Dump Truck		\$15.00	\$1.18	\$16.18
Truck Driver- Flatbed Truck		\$19.65	\$8.57	\$28.22
Truck Driver- Semi-Trailer-Truck		\$15.00	\$0.00	\$15.00
Truck Driver- Water Truck		\$15.00	\$4.11	\$19.11
Waterproofer		\$15.00	\$0.00	\$15.00
Welders-Receive rate prescribed for craft performing operation is which welding is incidental..				
Price Date: 5/2/2025 12:00:00 AM		DOL Ref #TX202402		

H. OTHER INFORMATION: HISD believes the information included in this RFCSP is materially accurate, however, HISD does not warrant this information to be free from errors or omissions. Proposers are encouraged to inspect the premises prior to submitting a response.

PROPOSAL REQUIREMENTS

Proposal Questionnaire – Due June 17, 2025 at 2:00 PM via Email

CHECK HERE

Proposal Attachments and Forms – Due June 19, 2025 at 2:00 PM via Ion Wave.

CHECK
HERE

Subcontractor Questionnaire – Due June 20, 2025 at 2:00 PM via Email

CHECK HERE

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Subcontractor Questionnaire – Provide answers to Subcontractor Questionnaire Section and provide A305s as applicable.

PROPOSAL QUESTIONNAIRE – DUE JUNE 17, 2025 AT 2:00 PM VIA EMAIL

Please provide the following information in the sequence and format prescribed by this questionnaire, in addition to any other information you believe is important for the District to know about your organization.

GENERAL FIRM INFORMATION AND REPUTATION QUESTIONS:

1. Name of Firm
2. Address of principal office
3. Phone Number
4. Fax Number
5. Type of Business Organization (Corporation, Partnership, etc.)
6. Year Founded
7. Contact Person (with telephone and email address)
8. Indicate the residency of your organization
9. State how many years your organization has been in business in its current capacity.
10. Has your organization operated under any former names? If so, list those names.
11. If your organization is a corporation, state the date of incorporation, the state of incorporation, president's name, vice president's name, secretary's name, and treasurer's name.
12. If your organization is a partnership, state the date of organization, type of partnership, and names of general partners.
13. If your organization is individually owned, state the date of organization and the name of the owner.
14. If your organization is a form other than those listed above, please describe it and name your principals.
15. List jurisdictions and trade categories in which your organization is legally qualified to do business and indicate registration or license numbers, if applicable.
16. List jurisdictions in which your organization's partnership or trade name is filed.
17. **DUE ON BID DAY:** Attach a financial statement, preferably audited, including your organization's latest balance sheet and income statement.
18. Provide the name of the bonding company your organization uses, including the name and address of an agent. Proof of ability to bond (and remaining total bonding capacity) will be required prior to selection.
19. Within the last five (5) years, has an officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? (If the answer is yes, please attach details).
20. Claims and suits: If the answer to any of the questions below is yes, please attach details:
 - 20.1. Has your organization ever failed to complete any work awarded to it?
 - 20.2. Are there any judgments, claims, arbitration proceedings or suits outstanding against your organization or its officers?
 - 20.3. Has your organization filed any lawsuits or requested arbitration with regard to construction contracts within the last five (5) years?
 - 20.4. Has your organization had any claims asserted against it in the last five (5) years?
21. Provide 3 project references including project name, final cost; project size, completion date, and owner contact information. **Please note that these references will be contacted, and responses will be used in scoring matrix.**

	Reference 1	Reference 2	Reference 3
Project Name Final Project Cost Project Size (Sq Ft) Completion Date Closeout Date Owners Contact: Name Title Email Phone			

22. List the categories of work that your organization normally performs with its forces. Would you propose to do any work with your own forces or bid all work to subcontractors?
23. Describe your organization's approach to this project. Include phasing, staging, work to be completed in each summer and work to be completed during the school year.
24. Describe your organization's approach on this project with keeping students, staff, contractors and parents safe and as separate as possible.
25. Describe your organization's concepts for working in a team relationship with the owner and Architect during construction for major projects.
26. What is your experience working with other owner consultants (e.g., a program manager) throughout the construction phase?
27. Describe the most common problem or challenge that you have encountered in school construction and your method for addressing the issue.
28. What do you bring to the project team that is unique?
29. Describe your organization's capability to deliver projects on time and the techniques employed to rectify schedules that have deviated from the anticipated timeline.
30. Provide information related to your firm's accident frequency rate for the last five (5) years, include any OSHA citations.
31. Describe your organization's safety program and provide your workers' compensation experience modification factor.
32. List any safety awards your company has received within the past five (5) years.
33. List any subcontractors in which your organization has some ownership and list the categories of work those subcontractors normally perform.
34. List the projects over \$20M your organization currently has in progress, out of the office submitting the proposal, giving the name and location of the project, owner, architect, contract amount, percent complete, and scheduled completion date for all projects submitted.
35. List all projects your organization has performed in the last five (5) years. Highlight any projects within the Houston/Southeast Texas area. Provide the name and location of each project, owner, architect, contract amount, status, and whether the project was completed on time and within budget for all projects presented.
36. Identify the Project Manager and Site Superintendent who will work on the project. Provide a resume and three (3) references for each individual. Include the number of projects and the total volume (dollars) of projects the two have completed together.
37. Provide the number and total project scale of anticipated projects that the proposed project manager will be working on through the duration of the project.

-
38. Describe your quality assurance program. Explain the methods used to ensure quality control during the Construction phase of a project and minimize the number of major deficiencies noted on the completion punch list and a minimum number of warranty item call backs during the warranty phase. Provide specific examples of how these techniques or procedures were used in any of the five (5) projects you identified above and the results achieved. Attach this information to your proposal.

SUBCONTRACTOR QUESTIONNAIRE – DUE JUNE 20, 2025 AT 2:00 PM VIA EMAIL

1. Provide a schedule of all proposed subcontractors which the Proposer intends to use for the work. Include the number of projects the GC has completed with each subcontractor.
2. For all major subcontractors (subcontracts over \$1 Million) provide AIA Document A305s.

PROPOSAL ATTACHEMENTS AND FORMS – DUE APRIL 3, 2025, AT 2:00 PM VIA ION WAVE

ATTACHMENT A
FELONY CONVICTION NOTIFICATION

Section 44.034, Notification of Criminal History, Subsection (a), states “a person or business entity that enters into a contract with a school district must give advance notice to the District if the person or an owner or operator of the business entity has been convicted of a felony. The notice must include a general description of the conduct resulting in the conviction of a felony.”

Subsection (b) states “a school district may terminate a contract with a person or business entity if the district determines that the person or business entity failed to give notice as required by Subsection (a) or misrepresented the conduct resulting in the conviction. The district must compensate the person or business entity for services performed before the termination of the contract.”

THIS NOTICE IS NOT REQUIRED OF A PUBLICLY-HELD CORPORATION. PLEASE COMPLETE THE INFORMATION BELOW.

I, undersigned agent for the firm named below, certify that the information concerning notification of felony conviction has been reviewed by me and the following information furnished is true to the best of my knowledge.

VENDOR’S NAME: _____

AUTHORIZED COMPANY OFFICIAL’S NAME (PRINTED):

A. My firm is publicly-held corporation; therefore, this reporting requirement is not applicable.

Signature of Company Official: _____

B. My firm is not owned nor operated by anyone who has been convicted of a felony.

Signature of Company Official: _____

C. My firm is owned or operated by the following individual(s) who has/have been convicted of a felony:

Name of Felon(s): _____

Details of Conviction(s): _____

Signature of Company Official: _____

ATTACHMENT B
HUFFMAN INDEPENDENT SCHOOL DISTRICT
NON-COLLUSION AFFIDAVIT

STATE OF TEXAS

COUNTY OF _____

_____, of lawful age, being duly sworn, on oath says, that (s)he is the agent authorized by the proposal to submit the attached proposal. Affiant further states that the proposer has not been a party to any collusion among proposal/proposers in restraint of freedom of competition by agreement to proposal at a fixed price or to refrain from proposing; or with any District employee, Board Trustee, or benefit consultant as to quantity, quality, or price in the prospective contract, or any other terms of said proposers and any District employee, Board Trustee, or benefit consultant concerning exchange of money or other things of value for special consideration in the letting of this contract.

Signature

Title of Above Signature

Subscribed and sworn to before me this _____ day of _____, 2025.

Notary Public

State of _____

My Commission Expires: _____

ATTACHMENT C
DISTRICT MODIFIED AIA CONTRACT A101/A101 EXHIBIT A/A201 – REFERENCE
EXHIBITS

See separate ATTACHMENT C on <https://huffmanisd.ionwave.net>

DRAFT AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of «July» in the year «2025»
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«Huffman Independent School District »« »
«24302 FM 2100 »
«Huffman, Texas 77336 »
«Telephone: (281) 324-1871 »

and the Contractor:
(Name, legal status, address and other information)

« »« »
«»
« »
« »

for the following Project:
(Name, location and detailed description)

« « Huffman ISD New CTE Center & Hargrave High School Additions & Renovations »
« »

The Architect:
(Name, legal status, address and other information)

PBK Architects,
11 Greenway Plaza Suite 22
Houston, TX 77046.

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

TABLE OF ARTICLES

- 1 THE CONTRACT DOCUMENTS
- 2 THE WORK OF THIS CONTRACT
- 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
- 4 CONTRACT SUM
- 5 PAYMENTS
- 6 DISPUTE RESOLUTION
- 7 TERMINATION OR SUSPENSION
- 8 MISCELLANEOUS PROVISIONS
- 9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

EXHIBIT B PROJECT MANUAL WITH SPECIFICATIONS AND DRAWINGS

EXHIBIT C CONTRACTOR QUOTE

EXHIBIT D PREVAILING WAGE RATES

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

(Check one of the following boxes.)

- ☐ The date of this Agreement.
- ☒ A date set forth in a notice to proceed issued by the Owner.
- ☐ Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

☐

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

[] Not later than () calendar days from the date of commencement of the Work.

[] ~~By the following date:~~ By the following dates: 2/28/2027

[] A date set forth in a notice to proceed issued by the Owner.

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
<u> </u>	<u> </u>

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be TBD (\$ 0), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
<u> </u>	<u> </u>

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance
<u> </u>	<u> </u>	<u> </u>

§ 4.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price
<u>Owner's Contingency</u>	<u>\$2,000,000.00</u>

§ 4.4 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit (\$0.00)
<u> </u>	<u> </u>	<u> </u>

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

- 1 Time is of the essence in all phases of the Work. It is specifically understood and agreed by and between Owner and Contractor that time is of the essence in the Substantial Completion and Final Completion of the Project and Owner shall sustain actual and direct damages as a result of Contractor's failure, neglect or refusal to achieve said deadlines. Such actual and direct damages are, and will continue to be, impracticable and extremely difficult to determine. Execution of this Agreement under these specifications shall constitute agreement by Owner and Contractor that the amounts stated below are the minimum value of the costs and actual and direct damages caused by failure of Contractor to substantially complete the work within the allotted times, that such sums are liquidated direct damages and shall not be construed as a penalty, and that such sums may be deducted from payments due Contractor if such delay occurs. It is expressly understood that the said sum per day is agreed upon as a fair estimate of the pecuniary damages which will be sustained by the Owner in the event that the Work is not completed within the agreed time, or within the agreed extended time, if any, otherwise provided for herein. Said sum shall be considered as liquidated damages only and in no sense shall be considered a penalty, said damages being caused by, but not limited to, additional compensation for personnel, attorneys fees, architectural fees, engineering fees, program management fees, inspection fees, storage costs, food service costs, transportation costs, utilities costs, costs of temporary facilities, loss of interest on money, and other miscellaneous increased costs, all of which are difficult to exactly ascertain. Failure to complete the Work within the designated or agreed extended dates of Substantial or Final Completion, shall be construed as a breach of this Agreement
- 2 It is expressly agreed as a part of the consideration inducing the Owner to execute this Agreement that the Owner may deduct from the Final Payment made to the Contractor a sum equal to \$500.00 per day for each and every additional calendar day beyond the agreed date of Substantial Completion.
- 3 Timely Final Completion is an essential condition of this Agreement. Contractor agrees to achieve Final Completion of the Agreement within 30 days of the designated or extended date of Substantial Completion. Owner and Contractor agree that should Contractor fail to achieve Final Completion of the Agreement by the deadline, Owner shall continue to be damaged to a greater degree by such delay. Contractor and Owner agree that the amount of liquidated damages for each calendar day Final Completion is delayed beyond the date set for Final Completion shall be the sum of \$500.00 per day. Owner may deduct from the Final Payment made to Contractor, or, if sufficient funds are not available, then Contractor shall pay Owner the amounts specified per day for each and every calendar day the breach continues after the deadline for Final Completion of the Work.
- 4 Such damages shall be in addition to, and not in lieu of, any other rights, claims or remedies Owner may have against Contractor. If the Work is not finally completed by the time stated in the Agreement, or as extended, no payments for Work completed beyond that time shall be made until the Project reaches Final Completion.

§ 4.6 Other:

(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

<< >>

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

<< >>

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the <last >> day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the <last >> day of the

«following » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than «forty-five » («45 ») days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™-2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 ~~That If approved in advance by the Owner, that~~ portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, ~~or, if approved in advance by the Owner, or~~ suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201-2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201-2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

«five percent (5%)»

§ 5.1.7.1.1 The following items are not subject to retainage:

(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

«Items legally required pursuant to Tex. Gov't Code, Chapter 2252, Subchapter B to be excluded, if any.»

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:

(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

«Any limits required by Tex. Gov't Code, Chapter 2252, Subchapter B.»

~~§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:~~

~~(Insert any other conditions for release of retainage upon Substantial Completion.)~~

«Retainage is not due to the Contractor until thirty-one (31) days after Final Completion of the Work as set out in Section 9.10 of AIA Document A201-2017. After the Certificate of Substantial Completion is accepted by the Owner, the Owner may, in its sole discretion and upon acceptance and consent of surety, make payment of retainage on all or a part of the Work accepted. »

~~§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201-2017.~~Intentionally deleted.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201-2017, and to satisfy other requirements, if any, which extend beyond final payment;
- .2 Contractor has submitted Consent of Surety to Final Payment; and
- ~~.2~~ .3 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than ~~30~~ 31 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

§ 5.3 Interest

~~Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.~~

~~(Insert rate of interest agreed upon, if any.)~~Delinquent payments are subject to the Texas Prompt Payment Act, Texas Government Code Chapter 2251.

~~%~~ « » % « »

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201-2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »

« »

§ 6.2 Binding Dispute Resolution

For any Claim ~~subject to, but~~ not resolved ~~by, by~~ mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

☐ Arbitration pursuant to Section 15.4 of AIA Document A201–2017

☒ Litigation in a court of competent jurisdiction

☐ Other (Specify)

☐

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

~~§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows: Intentionally deleted.~~

~~(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)~~

☐

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:

(Name, address, email address, and other information)

«Adam Skinner »
«Huffman Independent School District »
«24302 FM 2100 »
«Huffman, Texas 77336 »
«Telephone: (281) 324-1871»
«Email: askinner@huffmanisd.net »

§ 8.3 The Contractor's representative:

(Name, address, email address, and other information)

TBD

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The ~~Owner and the~~ Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with ~~a building information modeling exhibit, AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit~~, if completed, or as otherwise set forth below:

(If other than in accordance with ~~a building information modeling exhibit, AIA Document E203–2013~~, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

«See Section 1.7 of the AIA A201, General Conditions of the Contract»

§ 8.7 Other provisions:

«8.7.1 The Owner is the entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. All parties understand that only the Board of Trustees for the Owner, acting as a body corporate, has the express authority to bind the Owner with respect to Change Orders or Contract amendments as provided herein, except as may otherwise be delegated by the Board of Trustees.

8.7.2 Pursuant to Texas Government Code Chapter 2271, the Contractor represents and warrants to the Owner that the Contractor does not boycott Israel and will not boycott Israel during the term of this Agreement.

8.7.3 Contractor verifies and affirms that it is not a foreign terrorist organization as identified on the list prepared and maintained by the Texas Comptroller of Public Accounts. If Contractor has misrepresented its inclusion on the Comptroller's list, such omission or misrepresentation will void this Contract.

8.7.4 The Contractor represents and warrants to the Owner that the Contractor does not boycott energy companies as contemplated by Chapter 809 of the Government Code and will not boycott energy companies during the term of this Agreement.

8.7.5 The Contractor represents and warrants to the Owner that the Contractor does not discriminate against firearm and ammunition companies and trade associations as contemplated by Chapter 2274 of the Government Code and will not so discriminate during the term of this Agreement.

8.7.6 By signing this Agreement, the undersigned certifies as follows: Under Section 231.006 of the Texas Family Code, to the extent applicable to this Agreement, the Contractor certifies that the individual or business entity named in this Contract is not ineligible to receive the specified payments and acknowledges that this Agreement may be terminated and payment withheld in this certification is inaccurate.»

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- 1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- 2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- 3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- 4 ~~Building information modeling exhibit, dated as indicated below:~~
(Insert the date of the building information modeling exhibit incorporated into this Agreement.)« »

5 Drawings

4 Drawings

Number

See Exhibit B, Drawings and Specifications

Title

Date

6 5 Specifications

Section	Title	Date	Pages
<u>See Exhibit B, Drawings and Specifications</u>			

~~.7~~ .6 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

~~.8~~ .7 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

Exhibit C, Contractor Proposal
Exhibit D, Prevailing Wage Rates

[« »] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
 (Insert the date of the E204-2017 incorporated into this Agreement.)

« »

[« »] The Sustainability Plan:

Title	Date	Pages

[« »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

~~.9~~ .8 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™–2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

«Any other documents listed in Article 1. »

This Agreement entered into as of the day and year first written above.

HUFFMAN INDEPENDENT SCHOOL DISTRICT TBD

OWNER (Signature)

«Dr. Angeles Perez, »« Superintendent »
 (Printed name and title)

CONTRACTOR (Signature)

« »
 (Printed name and title)

DRAFT AIA® Document A101® – 2017

Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the « » day of « June » in the year «2025 »
(In words, indicate day, month and year.)

for the following **PROJECT**:
(Name and location or address)

«« Huffman ISD New CTE Center & Hargrave High School Additions & Renovations »»

THE OWNER:
(Name, legal status and address)

«Huffman Independent School District
24302 FM 2100
Huffman, Texas 77336 »« »
«Telephone: (281) 324-1871 »

THE CONTRACTOR:
(Name, legal status and address)

« TBD »

TABLE OF ARTICLES

- A.1 GENERAL
- A.2 OWNER'S INSURANCE
- A.3 CONTRACTOR'S INSURANCE AND BONDS
- A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL

The ~~Owner and~~ Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201™–2017, General Conditions of the Contract for Construction.

ARTICLE A.2 OWNER'S INSURANCE

§ A.2.1 General

~~Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.~~Intentionally deleted.

§ A.2.2 Liability Insurance

~~The Owner shall be responsible for purchasing and maintaining the Owner's usual general liability insurance.~~Intentionally deleted.

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Document A201®–2017, General Conditions of the Contract for Construction. Article 11 of A201®–2017 contains additional insurance provisions.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

§ A.2.3 Required Property Insurance

§ A.2.3.1 ~~Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.~~Intentionally deleted.

§ A.2.3.1.1 Causes of Loss. ~~The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:~~Intentionally deleted.

(Indicate below the cause of loss and any applicable sub-limit.)

Causes of Loss	Sub-Limit

§ A.2.3.1.2 Specific Required Coverages. ~~The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to falsework and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. Sub-limits, if any, are as follows:~~Intentionally deleted.

(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)

Coverage	Sub-Limit

§ A.2.3.1.3 ~~Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.~~Intentionally deleted.

§ A.2.3.1.4 Deductibles and Self-Insured Retentions. ~~If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.~~Intentionally deleted.

§ A.2.3.2 Occupancy or Use Prior to Substantial Completion. ~~The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.~~Intentionally deleted.

§ A.2.3.3 Insurance for Existing Structures

~~If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, "all risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co insurance penalties.~~Intentionally deleted.

§ A.2.4 Optional Extended Property Insurance.

~~The Owner shall purchase and maintain the insurance selected and described below.~~

Intentionally deleted. (Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)

- [☐] § A.2.4.1 Loss of Use, Business Interruption, and Delay in Completion Insurance, ~~to reimburse the Owner for loss of use of the Owner's property, or the inability to conduct normal operations due to a covered cause of loss.~~Intentionally deleted.

☐ ☐

- [☐] § A.2.4.2 Ordinance or Law Insurance, ~~for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.~~Insurance Intentionally deleted.

☐ ☐

- [☐] § A.2.4.3 Expediting Cost Insurance, ~~for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.~~Insurance Intentionally deleted.

☐ ☐

- [☐] § A.2.4.4 Extra Expense Insurance, ~~to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.~~Insurance Intentionally deleted.

☐ ☐

- [☐] § A.2.4.5 Civil Authority Insurance, ~~for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.~~Insurance Intentionally deleted.

☐ ☐

- [☐] § A.2.4.6 Ingress/Egress Insurance, ~~for loss due to the necessary interruption of the insured's business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.~~Insurance Intentionally deleted.

☐ ☐

- [☐] § A.2.4.7 Soft Costs Insurance, ~~to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.~~Insurance Intentionally deleted.

☐ ☐

§ A.2.5 Other Optional Insurance.

~~The Owner shall purchase and maintain the insurance selected below.~~

Intentionally deleted. (Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)

[☐] **§ A.2.5.1 Cyber Security Insurance** for loss to the Owner due to data security and privacy breach, including costs of investigating a potential or actual breach of confidential or private information. Intentionally deleted.
(Indicate applicable limits of coverage or other conditions in the fill point below.)

[☐]

[☐] **§ A.2.5.2 Other Insurance** Intentionally deleted.
(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage

Limits

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. It is the intent of the parties to this Agreement that the General Liability coverage required herein shall be primary to and shall seek no contribution from all insurance available to Owner, with Owner's insurance being excess, secondary and non-contributing. The Commercial General Liability coverage provided by Contractor shall be endorsed to provide such primary and non-contributing liability. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. In addition, the company must be acceptable to the Owner. The Owner's Representative will contact the State Board of Insurance to confirm that the issuing companies are admitted and authorized to issue such policies in the State of Texas. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

[☐]

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than «Two Million and No/100 Dollars » (\$ «2,000,000.00 ») each occurrence, «Two Million and No/100 Dollars » (\$ «1,000,000.00 ») general aggregate, and «Two Million and No/100 Dollars » (\$ «2,000,000.00 ») aggregate for products-completed operations hazard, providing coverage for claims including

- .1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
- .2 personal injury and advertising injury;
- .3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
- .4 bodily injury or property damage arising out of completed operations; and
- .5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

- .1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.
- .2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.
- .3 Claims for bodily injury other than to employees of the insured.
- .4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.
- .5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.
- .6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.
- .7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.
- .8 Claims related to roofing, if the Work involves roofing.
- .9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.
- .10 Claims related to earth subsidence or movement, where the Work involves such hazards.
- .11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than «One Million and No/100 Dollars » (\$ «1,000,000.00 ») per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers. Excess Liability shall have policy limits of not less than Five Million and No/100 Dollars (\$5,000,000.00) each occurrence and in the aggregate.

§ A.3.2.5 Workers' Compensation at statutory limits-limits for all liability arising out of Contractor's employment of workers and anyone for whom Contractor shall be liable for Worker's Compensation claims. Worker's Compensation is required and no "alternative" form of insurance shall be permitted.

A.3.2.5.1 Workers' Compensation Insurance Coverage.

.1 Definitions:

- .1 Certificate of coverage ("Certificate"). A copy of a certificate of insurance, a certificate of authority to self-insure issued by the division, or a coverage agreement (DWC Form-81, DWC Form-82, DWC Form-83, or DWC Form-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on the Project, for the duration of the Project.
- .2 Duration of the Project. Includes the time from the beginning of the work on the Project until the Contractor's work on the Project has been completed and accepted by the Owner.
- .3 Persons providing services on the Project ("subcontractor" in Texas Labor Code §406.096). Includes all persons or entities performing all or part of the services the Contractor has undertaken to perform on the Project, regardless of whether that person contracts directly with the Contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the Project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a Project. "Services" does not include activities unrelated to the Project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.
- .2 The Contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the Contractor providing services on the Project, for the duration of the Project.
- .3 The Contractor must provide a certificate of coverage to the Owner prior to being awarded the contract.
- .4 If the coverage period shown on the Contractor's current certificate of coverage ends during the duration of the Project, the Contractor must, prior to the end of the coverage period, file a new certificate of coverage with the Owner showing that coverage has been extended.
- .5 The Contractor shall obtain from each person providing Services on a Project, and provide to the Owner:
 - .1 a certificate of coverage, prior to that person beginning work on the Project, so the Owner will have on file certificates of coverage showing coverage for all persons providing services on the Project; and
 - .2 no later than seven (7) days after receipt by the Contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project.
- .6 The Contractor shall retain all required certificates of coverage for the duration of the Project and for one (1) year thereafter.
- .7 The Contractor shall notify the Owner in writing by certified mail or personal delivery, within ten (10) days after the Contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project.
- .8 The Contractor shall post on each Project site a notice, in the text, form and manner prescribed by the Texas Department of Insurance, Division of Workers' Compensation, informing all persons providing services on the Project that they are required to be covered, and stating how a person may verify coverage and report lack of coverage.
- .9 The Contractor shall contractually require each person with whom it contracts to provide services on a Project, to:
 - .1 provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the Project, for the duration of the Project;
 - .2 provide to the Contractor, prior to that person beginning work on the Project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the Project, for the duration of the Project;
 - .3 provide the Contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
 - .4 obtain from each other person with whom it contracts, and provide to the Contractor:
 - (a) a certificate of coverage, prior to the other person beginning work on the Project; and
 - (b) a new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the Project;
 - .5 retain all required certificates of coverage on file for the duration of the Project and for one (1) year thereafter;

- .6 notify the Owner in writing by certified mail or personal delivery, within ten (10) days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the Project; and
- .7 contractually require each person with whom it contracts, to perform as required by Subparagraphs .9.1 - .9.7 with the certificates of coverage to be provided to the person for whom they are providing services.
- .10 By signing this contract or providing or causing to be provided a certificate of coverage, the Contractor is representing to the Owner that all employees of the Contractor who will provide services on the Project will be covered by workers' compensation coverage for the duration of the Project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the Texas Department of Insurance, Division of Self-Insurance Regulation. Providing false or misleading information may subject the Contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.
- .11 The Contractor's failure to comply with any of these provisions is a breach of contract by the Contractor which entitles the Owner to declare the contract void if the Contractor does not remedy the breach within ten (10) days after receipt of notice of breach from the Owner. [28 TAC Rule §(a)(7)]

§ A.3.2.6 Employers' Liability with policy limits not less than «One Million and No/100 Dollars » (\$ «1,000,000.00 ») each accident, «One Million and No/100 Dollars » (\$ «1,000,000.00 ») each employee, and «One Million and No/100 Dollars » (\$ «1,000,000.00 ») policy limit.

§ A.3.2.7 ~~Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks.~~ Intentionally deleted.

§ A.3.2.8 ~~If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than ■ (\$ ■) per claim and ■ (\$ ■) in the aggregate.~~ Intentionally deleted.

§ A.3.2.9 ~~If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than ■ (\$ ■) per claim and ■ (\$ ■) in the aggregate.~~ Intentionally deleted.

§ A.3.2.10 ~~Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than ■ (\$ ■) per claim and ■ (\$ ■) in the aggregate.~~ Intentionally deleted.

§ A.3.2.11 ~~Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than ■ (\$ ■) per claim and ■ (\$ ■) in the aggregate.~~ Intentionally deleted.

§ A.3.2.12 ~~Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than ■ (\$ ■) per claim and ■ (\$ ■) in the aggregate.~~ Intentionally deleted.

§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

« »

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.

(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

[☒] § A.3.3.2.1 Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such ~~insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below.~~ insurance. The Contractor shall disclose to the Owner the amount of any deductible, and the ~~Owner-Contractor~~ shall be responsible for losses within the deductible. The Contractor shall pay the difference attributable to deductions in any payment made by the insurance carrier on claims paid by this insurance. If the Owner is damaged by the failure of the Contractor to maintain such insurance and to so notify the Owner then the Contractor shall bear all reasonable costs properly attributable thereto. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:
(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below.
Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

<< >>

[☐] § A.3.3.2.2 Railroad Protective Liability Insurance, with policy limits of not less than << >> (\$ << >>) per claim and << >> (\$ << >>) in the aggregate, for Work within fifty (50) feet of railroad property.

[☐] § A.3.3.2.3 Asbestos Abatement Liability Insurance, with policy limits of not less than << >> (\$ << >>) per claim and << >> (\$ << >>) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[☐] § A.3.3.2.4 Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[☐] § A.3.3.2.5 Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

[☒] § A.3.3.2.6 Other Insurance Property insurance on an "All Risk" completed value form against the perils of fire, lightning, windstorm, hurricane, hail, explosion, riot, civil commotion, smoke, aircraft, land vehicles, vandalism, malicious mischief, and all other perils in the amount of one hundred percent (100%) of the value of the improvements, including transit and materials stored off-site. Additionally, this coverage shall provide protection to the full replacement value for boiler and machinery equipment up to installation, during testing, and until acceptance by Owner.
(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage

Limits

A.3.3.3 Contractor and its Subcontractors shall not commence the shipment of equipment or materials or commence the Work at the site until all of the insurance coverage required of Contractor and its Subcontractors are in force and the necessary certificates and statements pursuant to Section A.3.1.1 hereof have been received by Owner and the Architect has issued a written notice to proceed.

A.3.3.4 The Owner and Contractor shall waive all rights against (1) each other and the Contractors, Subcontractors, agents and employees each of the other, and (2) the Architect and separate Contractors, if any, and their contractors, Subcontractors, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance applicable to the Work. The foregoing waiver afforded the Architect, his agents and employees shall not extend to the liability imposed by Section 3.18.3. The Owner or the Contractor, as appropriate, shall require of the Architect, separate contractors, contractors and Subcontractors by appropriate agreements, written where legally required for validity, similar waivers, each in favor of all other parties enumerated in this Section A.3.3.4.

§ A.3.4 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows: Intentionally deleted.
(Specify type and penal sum of bonds.)

A.3.4.1 The Contractor is required, as a condition precedent to the execution of the Contract, to execute a PERFORMANCE BOND in the form required by TEXAS STATUTES, in an amount equal to ONE HUNDRED PERCENT (100%) of the Contract Sum.

A.3.4.2 The Contractor is required, as a condition precedent to the execution of the Contract, to execute a PAYMENT BOND in the form required by TEXAS STATUTES, in an amount equal to ONE HUNDRED PERCENT (100%) of the Contract Sum as security for payment of all persons performing labor and furnishing materials in connection with this Contract. (Bonding Company is to furnish such forms). All bonds shall name the Owner as additional obligee.

A.3.4.3 The Payment and Performance Bond shall meet requirements of Chapter 2253 of the Texas Governmental Code. All bonds shall be issued by a surety company licensed, listed and authorized to issue bonds in the State of Texas by the Texas Department of Insurance. The surety company may be required by the Owner to have a rating of not less than "B" in the latest edition of Best's Insurance Reports, Property-Casualty. The surety company shall provide, if requested, information on bonding capacity, other projects under coverage and shall provide proof to establish adequate financial capacity for this Project.

(Specify type and penal sum of bonds.) Should the bond amount be in excess of ten percent (10%) of the surety company's capital and surplus, the surety company issuing the bond shall certify that the surety company has acquired reinsurance, in a form and amount acceptable to the Owner, to reinsure the portion of the risk that exceeds ten percent (10%) of the surety company's capital and surplus with one or more reinsurers who are duly authorized and admitted to do business in Texas and that amount reinsured by an reinsurer does not exceed ten percent (10%) of the reinsurer's capital and surplus.

The Sureties shall promptly file a signed copy of the Contract, Performance, and Payment Bonds with the Owner in full compliance with Chapter 2253 of the Texas Governmental Code.

Type

Penal Sum (\$0.00)

Payment Bond

Performance Bond

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement. **A.3.4.4** All bonds will be reviewed by the Architect for compliance with the Contract Documents prior to execution of the contract. In the event that the Architect has any questions concerning the sufficiency of the bonds, the bonds will be referred to the Owner or the Owner's representative for review and decision.

A.3.4.5 All bonds shall be originals. The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the Power-of-Attorney. The name, address, and telephone number of a contact person for the bonding company shall be provided.

A.3.4.6 Upon the request in writing of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.

A.3.4.7 Bonds shall be signed by an agent resident in the State of Texas and the date of the bond shall be the date of execution of the contract. If at any time during the continuance of the contract, the surety of the Contractor's bonds becomes insufficient, Owner shall have the right to require additional and sufficient sureties which the Contractor shall furnish to the satisfaction of the Owner within ten (10) business days after notice to do so. In default thereof, the Contractor may be suspended, and all payment or money due to the Contractor withheld.

A.3.4.8 By inclusion of this Section A.3.4.8 in the Contract Documents, the surety which issues the bonds is hereby notified that the Owner, the Architect, and their agents and employees do not represent and will not be responsible for the surety's interests during the course of the Work. To protect its interests, the surety shall have the right to attend pay estimate meetings, review Applications for Payment when requested in writing by them, comment upon and make recommendations regarding payments and inspect the Work in the presence of the Contractor and the Architect. By providing the bonds for the Work, the surety shall and hereby waives any cause of action against the Owner, the Architect, their agents and employees, for any loss suffered by the surety by reason of overpayment of any amounts to the Contractor, unless such is a direct result of a fraudulent or grossly negligent act committed by such party.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

<< >>

DRAFT AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:
(Name and location or address)

«« [Huffman ISD New CTE Center & Hargrave High School Additions & Renovations](#) »
« »

THE OWNER:
(Name, legal status and address)

«[Huffman Independent School District](#)
[24302 FM 2100](#)»
«[Huffman, Texas 77336](#) »
«[Telephone: \(281\) 324-1871](#) »
« »

THE ARCHITECT:
(Name, legal status and address)

«
[PBK Architects,](#)
[11 Greenway Plaza Suite 22](#)
[Houston, TX 77046](#)

THE CONTRACTOR:

« [TBD](#) »

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ADDITIONS AND DELETIONS:
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements. The Contract Documents identified in this Section shall prevail in case of an inconsistency with subsequent versions made through manipulatable electronic operations. In the absence of individual signatures by Owner and Contractor, the Contract Documents identified in the signed contract prevail.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a written Modification. After execution of the Original Contract Documents, the Contract may thereafter be amended or modified only by a written Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

~~Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.~~

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

1.1.9 The terms "bids" or "bidding" shall include any kind of competitive purchasing under the Texas Education Code Chapter 44 and Texas Government Code Chapter 2269.

1.1.10 MISCELLANEOUS OTHER WORDS

1.1.10.1 BUSINESS DAY

The term "business day" is a day the Owner's Administration Building is scheduled to be open for normal business purposes, unless closed by the Owner's Superintendent of Schools for inclement weather or other reason. Days on which the Administration Building is normally closed are Thanksgiving Break, Winter Break, Spring Break, and Summer Break, as well as other federal, state or local days specified in the calendar approved by the Owner's Board of Trustees on an annual basis. A business day does not include a day on which the Owner's Administration Building is open only for the purposes of conducting candidate filing, early voting, elections, or special events.

1.1.10.2 CALENDAR DAY

A calendar day is a day on the Gregorian calendar. The Contact Time is established in calendar days. Extensions of time granted, if any, will be converted to calendar days.

1.1.10.3 HOLIDAYS

Owner approved holidays for Contractor's Work are limited to New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the day after Thanksgiving, and Christmas Day.

1.1.10.4 WORK DAY

Work days include all calendar days except Holidays, Saturdays and Sundays.

1.1.10.5 ADDENDA/ADDENDUM

Documents issued by the Architect prior to execution of the Owner Contractor Agreement for this Project that modify or clarify the Proposal Documents. All addenda become a part of the Contract Documents.

1.1.10.6 ALTERNATE PROPOSALS

A separate amount stated on a separate Proposal Form, which, if accepted by the Owner, will be added to or deducted from the Base Proposal. If accepted, the work that corresponds to the alternate proposal will become part of the agreement between Owner and Contractor. Alternate proposals shall remain valid for the same period of time as the Base Proposal after receipt of proposals, regardless if an Owner Contractor Agreement has been executed, unless indicated otherwise herein.

1.1.10.7 APPROVED, APPROVED EQUIVALENT, APPROVED EQUAL, OR EQUAL

The terms Approved, Approved Equivalent, Approved Equal, and or Equal, relate to the substitution of products or systems approved in writing by the Architect. Refer to Paragraph 3.4.2, Substitution of Products and Systems, for procedures which must be followed after award of contract. The substitution procedure process to be followed prior to receipt of proposals is described in the Instructions to Bidders.

1.1.10.8 BASE PROPOSAL

The Contractor's proposal for the Work, not including any Alternates.

1.1.10.9 CONTRACT TIME

The period of time which is established in the Contract Documents for Substantial Completion of the Work.

1.1.10.10 DATE OF AGREEMENT

The date the Owner formally awards a Contract for Construction of the Work. This date will be inserted on the first page of the Agreement between Owner and Contractor and shall be referenced in Performance Bond and Payment Bond forms. See also Date of Commencement of the Work.

1.1.10.11 DATE OF COMMENCEMENT OF THE WORK

The date of a written Notice to Proceed to the Contractor for a given portion of the Work. This date constitutes day zero (0) of the stated Contract Time. The Notice to Proceed will be issued after the Owner has received and validated the Contractor's Payment Bond, Performance Bond and Insurance.

1.1.10.12 DATE OF FINAL COMPLETION

The end of construction. See Section 9.10.

1.1.10.13 NOTICE TO PROCEED

A notice that may be given by the Owner to the Contractor that directs the Contractor to start the Work. It may also establish the Date of Commencement of the Work.

1.1.10.14 PROVIDE

Whenever the word "provide" is used in these documents, it shall mean the same as "furnish and install."

1.1.10.15 PUNCH LIST

A comprehensive list prepared by the Contractor prior to Substantial Completion to establish all items to be completed or corrected; this list may be supplemented by the Architect or Owner. See Section 9.8.

1.1.10.16 UNIT PRICES

A cost for a unit of work as described in the Contract Documents. The Owner may add or deduct Unit Price work at the amounts stated in the Proposal Form and such amounts shall not be subject to additional mark up by the Contractor or its subcontractors.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

1.2.1.2 During the course of the Work, should any conflict be found in or between the Contract Documents, the Contractor shall be deemed to have included in the cost of the Work the greater quantity or better quality, or the most stringent requirements, unless Contractor shall have obtained, before the submission of Contractor's Proposal, an interpretation in writing from the Architect as to what shall govern. The Architect, in case of such conflict, may interpret or construe the document so as to obtain the most substantial and complete performance of the Work consistent with the Contract Documents and reasonably inferable therefrom, in the best interests of Owner, and the Architect's interpretation shall be final. The terms and conditions of this clause shall not relieve any party of any other obligation under the Contract Documents.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 PRECEDENCE OF THE CONTRACT DOCUMENTS

The most recently issued Document takes precedence over previous issues of the same Document. The order of precedence is as follows with the highest authority listed as "1".

- .1 Contract Modifications signed by Contractor and Owner.
- .2 Agreement – AIA Document A101-2017, as modified by the Owner for the Project.

- .3 Supplementary Conditions.
- .4 General Conditions - AIA Document A201-2017, as modified by the Owner for the Project.
- .5 Addenda, with those of later date having precedence over those of earlier date.
- .6 Drawings and Specifications.

§ 1.2.5 RELATION OF SPECIFICATIONS AND DRAWINGS

Specifications and Drawings are to be equivalent in authority and priority. Should they disagree in themselves, or with each other, prices shall be based on the better quality and greater quantity of Work indicated. In the event of the above mentioned disagreements, the resolution shall be determined by the Architect.

§ 1.2.6 Where, in the Drawings and Specifications, certain products, manufacturer's trade names, or catalog numbers are given, it is done for the express purpose of establishing a standard of function, dimension, appearance, and quality of design, in harmony with the Work, and is not intended for the purpose of limiting competition. Materials or equipment shall not be substituted unless such substitution has been specifically accepted for use on this Project by the Architect.

1.2.7 When the Work is governed by reference to standards, building codes, manufacturer's instructions, or other documents, unless otherwise specified, the current edition as of the Agreement date shall a

1.2.8 Requirements of public authorities apply as minimum requirements only and do not specified requirements.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights, rights

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon ~~written~~ protocols governing the transmission and use of, and reliance on, of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

~~Any use of, or reliance on, all or a portion of a building information model without agreement to written protocols governing the use of, and reliance on, the information contained in the model shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.~~

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

~~§ 2.1.1 The Owner is the person or entity identified as such in the Agreement Board of Trustees of the Huffman Independent School District and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. may designate in writing one or more persons to represent the Owner; however, such representatives shall have the authority to bind the Owner only to the extent expressly authorized by the Owner and shall have no implied authority. Except as otherwise provided in Section 4.2.1, the Architect does not have the authority to bind the Owner. The term "Owner" means the Owner or the Owner's authorized representative.~~

~~§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein may engage a third-party consultant to represent the Owner. The Owner will notify the Contractor of the identity of such consultant.~~

~~2.1.3 The Contractor acknowledges that no lien rights exist with respect to public property.~~

§ 2.2 Evidence of the Owner's Financial Arrangements

~~§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately. Pursuant to the requirements of Texas Business and Commerce Code section 56.054(e)(3), the Owner represents that funds are available and have been authorized for the full contract amount of the Work .~~

~~§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor~~

~~may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start up, plus interest as provided in the Contract Documents.~~Intentionally deleted.

~~§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.~~Intentionally deleted.

~~§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.~~Intentionally deleted.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site.~~The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.~~

~~**§ 2.3.5** The Owner shall furnish information~~Information ~~or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services shall be furnished by the Owner within a reasonable time following actual receipt of a written request.~~

~~**§ 2.3.6** Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2. The Contractor, Owner and Architect shall agree on an appropriate quantity of drawings and specifications to be printed and distributed for bidding purposes. The drawings shall be provided by the Architect and paid for by the Owner.~~

§ 2.4 Owner's Right to Stop the Work

~~If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.~~**§ 2.4.1** If the Contractor fails to correct Work nonconforming or defective Work as required by Section 12.2, or fails to complete the Work on time as required by Article 3 of the Agreement or is in default of any of its material obligations hereunder, the Owner, by a written order signed by an agent specifically so empowered by the Owner, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to

stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. This right shall be in addition to, and not in restriction of, the Owner's right under Section 12.2.

§ 2.5 Owner's Right to Carry Out the Work

~~If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.~~

§ 2.5.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a three-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. The Architect or Owner may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

2.6 OWNER'S LACK OF LIABILITY TO THIRD PARTY

2.6.1 The Owner is not responsible for the acts and/or omissions of, or contractually involved with, any subcontractors, suppliers of labor or materials, and/or their respective employees or agents or any other third-party claimants. Such claimants shall not constitute third party beneficiaries under this Contract. The Contractor and/or his Surety solely shall deal with, take responsibility for, and be liable to such parties under this Contract. Contractor will indemnify and defend the Owner from any legal actions against Owner for unpaid bills of subcontractors.

2.7 OWNER'S RIGHT TO OCCUPY THE PROJECT

2.7.1 The Owner shall have the right to occupy or use without prejudice to the right of either party, any completed or largely completed portions of the project, notwithstanding the time for completing the entire work or such portions may not yet have expired. Such occupancy and use shall not constitute acceptance of any work not in accordance with the Contract Documents. If the Contractor determines that said occupancy may cause a delay to the completion of the project, he shall notify the Owner in writing immediately.

2.7.2 Refer to Article 11 Insurance and Bonds regarding property insurance requirements in the event of such occupancy.

2.7.3 If Contractor has not completed the obligations of the Contract Documents by the dates established by subsequent Amendments to the Agreement between Owner and Construction Manager, the Owner shall have the right to occupy or use the entire project.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents, a good and workmanlike manner except to the extent the Contract Documents expressly specify a higher degree of finish or workmanship.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Owner or Owner's consultants, if applicable, conducted in accordance with the Contract Documents or activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents. The Contractor and each Subcontractor shall evaluate and satisfy themselves as to the conditions and limitations under which the Work is to be performed, including without limitation: (1) the location, condition, layout and nature of the Project site and surrounding areas, (2) generally prevailing climatic conditions, (3) anticipated labor supply and costs, (4) availability and cost of materials, tools and equipment, and (5) other similar issues. The Owner assumes no responsibility or liability for the physical condition or safety of the Project site or any improvements located on the Project site, or for price escalations in the marketplace. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time in connection with any failure by the Contractor or any Subcontractor to comply with the requirements of this Section.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

.1 The exactness of grades, elevations, dimensions, or locations given on any Drawings issued by the Architect, or the Work installed by other contractors, is not guaranteed by the Architect or the Owner.

.2 The Contractor shall, therefore, satisfy itself as to the accuracy of all grades, elevations, dimensions, and locations. In all cases of interconnection of its Work with existing or other Work, it shall verify at the site all dimensions relating to such existing or other Work. Any errors due to the Contractor's failure to so verify all such grades, elevations, dimensions, or locations shall be promptly rectified by the Contractor without any additional cost to the Owner.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

3.2.5 Notwithstanding the delivery of a survey or other documents by the Owner, Contractor shall use reasonable efforts to perform all Work in such a manner so as to avoid damaging any utility lines, cables, pipes, or pipelines on the property. Contractor shall be responsible for, and shall repair at Contractor's own expense, any damage done to lines, cables, pipes, and pipelines identified to Contractor.

3.2.6 The Owner and Contractor agree that the Contract Documents may not be free from errors, inconsistencies, or omissions, and further agree that the Owner makes no warranty as to the completeness or accuracy of the Contract documents, either express or implied. Execution of the Contract by the Contractor is a representation that the Contractor has thoroughly reviewed and become familiar with the Contract Documents and that the Contractor is not aware of any errors, inconsistencies or omissions in the Contract Documents which would delay the Contractor in the performance of the Contract Work. The Contractor shall not be entitled to any damages or increase in the Contract Amount due to delays or disruptions to the Work. This limitation on damages is further subject to the limitations set forth in Section 15.1.7.

3.2.7 The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for the Architect to evaluate and respond to the Contractor's request for information, where such information was available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner provided information, Contractor prepared coordination drawings, or prior Project correspondence or documentation.

3.2.8 The Contractor shall use the AIA Document G716-2004 "REQUEST FOR INFORMATION" (RFI) form unless otherwise provided in the Contract Documents. The Contractor shall keep a log of all RFI's submitted and number the RFI's consecutively beginning with the number 1.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

3.3.1.1 The Contractor shall assign a superintendent who shall make decisions on behalf of the Contractor and its Subcontractors. The superintendent shall be on the Project, in this capacity, at all times while Work on the Project is in progress.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.3.4 Contractor shall bear responsibility for design and execution of acceptable trenching and shoring procedures, in accordance with Texas Government Code, Section 2166.303 and Texas Health and Safety Code, chapter C, Sections 756.021, et seq.

3.3.5 It is understood and agreed that the relationship of Contractor to Owner shall be that of an independent Contractor. Nothing contained herein or inferable herefrom shall be deemed or construed to (1) make Contractor the agent, servant, or employee of the Owner, or (2) create any partnership, joint venture, or other association between Owner and Contractor. Any direction or instruction by Owner in respect of the Work shall relate to the results the Owner desires to obtain from the Work, and shall in no way affect Contractor's independent contractor status as described herein.

3.3.6 The Contractor shall review contractor safety programs, procedures, and precautions in connection with performance of the Work. However, the Contractor's duties shall not relieve any Subcontractor(s) or any other person or entity (e.g. a supplier) including any person or entity with whom the Contractor does not have a

contractual relationship, of their responsibility or liability relative to compliance with all applicable federal, state and local laws, rules, regulations, and ordinances which shall include the obligation to provide for the safety of their employees, persons, and property and their requirements to maintain a work environment free of recognized hazards. The foregoing notwithstanding, the requirements of this Section are not intended to impose upon the Contractor any additional obligations that the Contractor would not have under any applicable state or federal laws including, but not limited to, any rules, regulations, or statutes pertaining to the Occupational Safety and Health Administration.

3.3.7 Contractor acknowledges that the Work may be performed in connection with an educational facility which is currently occupied and in use. It is imperative that Contractor's operations and the performance of the Work not interfere with, interrupt, disturb, or disrupt Owner's normal operations or facilities. Contractor agrees to and shall comply with all rules, regulations and requirements of the Owner and the school campus on which the Work is to be performed and shall take all steps necessary to protect and guard the safety of the employees, students and invitees of Owner. Contractor shall exercise the utmost skill and judgment to ensure that continuing construction activity will not interfere with the use, occupancy and quiet enjoyment of facilities in use on the site. Contractor recognizes that the ongoing activities in proximity with its construction activities shall result in the need for prompt and effective coordination of its services with those involved in the ongoing utilization of the premises. Such coordination and adequate site access shall be the responsibility of Contractor. Contractor understands and accepts the difficulties and costs associated with working in an existing facility and the potential delays and disruptions in its Work and has included such items in the Contract Time and the Contract Sum. The Contractor shall perform all the Work in such a manner as to cause minimum interference with the operations of the Owner and other contractors and Subcontractors on the site, and shall take, and cause the Contractor's and its Subcontractor's employees, agents, licensees and permittees to take all necessary precautions to protect the Work and the site and all persons and property thereon from damage or injury.

3.3.8 Representatives of the Owner, Contractor, and Architect shall meet periodically at mutually agreed upon intervals, for the purpose of establishing procedures to facilitate cooperation, communication, and timely responses among the participants. By participating in this arrangement, the parties do not intend to create additional contractual obligations or modify the legal relationships which may otherwise exist.

3.3.9 The Owner may require that the Contractor use and/or respond to certain Owner-furnished forms or inquiries during the course of the Project. From time to time, there may be future revisions, changes, additions or deletions to these forms. The fact that the Owner modifies and increases reasonable reporting requirements shall not serve as the basis for a claim for additional time or compensation by the Contractor.

3.3.10 In the event Contractor shall fall behind schedule at any time, for any reason, Owner shall be entitled to direct acceleration or resequencing of the Work to bring the Work back on scheduled. Contractor shall be entitled to compensation from the Construction Contingency, or if such contingency funds are exhausted, pursuant to Change Order, for such acceleration only (a) to the extent necessitated by excusable and compensable delays, and (b) to the extent of premium pay and additional equipment cost actually incurred by Contractor. In the event Contractor determines that he Scheduled Completion Date cannot be met by resequencing the Work, then Contractor shall immediately provide to the Owner, and in any event within seven (7) days after the date of receipt of any request by Owner for resequencing or acceleration, a plan to complete the Work in the shortest possible time. No approval by the Owner of any plan for resequencing or acceleration of the Work submitted by Contractor pursuant to this paragraph shall constitute a waiver by Owner of any damages or losses which Owner may suffer by reason of such resequencing or the failure of Contractor to meet the Scheduled Completion Date.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. The Contractor shall pay fees for public or private water, gas, electrical and other utility service at the site. The Contractor shall secure and arrange for all necessary utility connections.

3.4.1.1 PREVAILING WAGES

The Project is subject to the Texas Government Code, Chapter 2258, Prevailing Wage Rates. This statute requires the Contractor and any Subcontractor to pay not less than the prevailing rates of per diem wages in the locality at the time of construction to all laborers, workmen, and mechanics employed by them in the execution of the contract.

3.4.1.2 In accordance therewith, the Owner has established a scale of prevailing wages which is incorporated in the Project specifications, and not less than this established scale must be paid on the Project. Any workers not included in the schedule shall be properly classified and paid not less than the rate of wages prevailing in the locality of the Work at the time of construction. See also Exhibit D to the Contract, further setting forth the established Prevailing Wage Rates.

3.4.1.3 A Contractor or Subcontractor who violates the provisions of Sections 3.4.1.1 or 3.4.1.2 shall pay to Owner the sum of Sixty Dollars and No/100 (\$60.00) for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rate stipulated in the scale of prevailing wages applicable to this Project, as required by Texas Government Code Section 2258.023(b).

~~§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive. Intentionally deleted.~~

§ 3.4.2.1 Substitutions and alternates may be rejected without explanation and will be considered only under one or more of the following conditions: (i) the proposal is required for compliance with interpretation of code requirements or insurance regulations then existing; (ii) specified products are unavailable through no fault of the Contractor; and (iii) when in the judgment of the Owner or the Architect, a substitution would be substantially in the Owner's best interests, in terms of cost, time, or other considerations.

§ 3.4.2.2 The Contractor must submit to the Architect and the Owner (i) a full explanation of the proposed substitution and submittal of all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other information necessary for a complete evaluation of the substitution; (ii) a written explanation of the reasons the substitution is necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable; (iii) the adjustment, if any, in the Contract Sum; (iv) the adjustment, if any, in the time of completion of the Contract and the construction schedule; and (v) an affidavit stating the (a) the proposed substitution confirms to and meets all the requirements of the pertinent Specifications and the requirements shown on the Drawings, and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted in triplicate to the Architect in sufficient time to allow the Architect no less than twenty-one (21) working days for review. No substitutions will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated hereinbefore.

3.4.2.3 Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitute.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them. The Contractor shall be responsible for the actions of Contractor's forces, Subcontractor's forces and all tiers of Sub-subcontractor's forces. The Contractor recognizes that the Project Site is a public school campus, and will prohibit the possession or use of alcohol, controlled stances, tobacco, and any prohibited weapons on the Project Site and shall require adequate dress of the Contractor's forces consistent with the nature of the Work being performed, including wearing shirts at all times. Sexual harassment of employees of the Contractor or employees or students of the Owner by employees of the Contractor is strictly forbidden. Any employee of the Contractor who is found to have engaged in such conduct shall be subject to appropriate disciplinary action by the Contractor, including removal from the job site.

§ 3.4.4 The Contractor shall only employ or use labor in connection with the Work capable of working harmoniously with all trades, crafts, and any other individuals associated with the Project.

3.4.5 CRIMINAL HISTORY RECORDS CHECKS

3.4.5.1 Contractor shall obtain all criminal history information required by Texas Education Code Chapter 22.0834 or cause such information to be provided to Owner, the Texas Department of Public Safety ("DPS") or such entity as is designated by Owner for any employees required by statute to submit to a fingerprint-based background check through the DPS FACT Clearinghouse of Texas. Contractor will cooperate with Owner to determine which Contractor employees, if any, are required to submit to such background check. Before beginning any Work on the Project, Owner and Contractor will confer and ensure that any such required employees undergo a check, and Contractor shall fully cooperate with Owner during this process. Upon request by Owner, Contractor will provide any requested information regarding applicable employees, so that the Owner may obtain criminal history recommended information on such employees. Contractor shall assume all expenses associated with obtaining criminal history record information.

3.4.5.2 Contractor will not assign any "covered employee" with a "disqualifying criminal history," as those terms are defined below, to work on the Project. If Contractor receives information that a covered employee has a reported disqualifying criminal history, including any such information shared by Owner, then Contractor will immediately remove the covered employee from the Project and notify the Owner in writing within three (3) business days. If the Owner objects to the assignment of any covered employee on the basis of the covered employee's criminal history record information, then Contractor agrees to discontinue using that covered employee to provide services on Owner's Project. If Contractor has taken precautions or imposed conditions to ensure that the employees of Contractor and any of Contractor's subcontractors will not become covered employees, Contractor will ensure that these precautions or conditions continue throughout the time the contracted services are provided.

3.4.5.3 For the purposes of this Section, "covered employees" means employees, agents, or subcontractors of Contractor or any of Contractor's consultants who has or will have continuing duties related to the services to be performed on Owner's Project and has or will have direct contact with Owner's students. The Owner will decide what constitutes direct contact with Owner's students. "Disqualifying criminal history" means any conviction or other criminal history information designed by the Owner, or one of the following offenses: if at the time of the offense, the victim was under 18 years of age or enrolled in a public school; a felony offense under Texas Penal Code Title 5 Offense Against Persons; an offense for which a defendant is required to register as a sex offender under Texas Code of Criminal Procedure Chapter 62; or an equivalent offense under federal law or the laws of another state.

3.4.5.4 Any subcontractor entity of the Contractor shall be required by the terms of their contract with Contractor to comply with the same terms set forth above regarding such subcontracting entity's employees.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.5.3 The Contractor agrees to assign to the Owner at the Time of Final Completion of the Work any and all manufacturer's warranties relating to materials and labor used in the Work and further agrees to perform the Work in such manner so as to preserve any and all such manufacturer's warranties. As a condition precedent to final payment, the Contractor shall submit to Owner a complete set of warranties from contractors, manufacturers, or suppliers as appropriate, and executed by Contractor as required, with a warranty commencement date as required by the Contract Documents.

§ 3.5.4 Contractor's express warranty herein shall be in addition to, and not in lieu of, any other remedies Owner may have under this Agreement, at law, or in equity for defective Work.

§ 3.5.5 The warranties provided in Section 3.5 shall be in addition to and not in limitation of any other warranty or remedy required by law or by the Contract Documents, and such warranty shall be interpreted to require Contractor to replace defective materials and equipment and re-execute defective Work which is disclosed to the Contractor by the Owner within a period of one (1) year after Substantial Completion of the entire Work or if latent defect, within one (1) year after discovery thereof by Owner.

§ 3.5.6 The Contractor shall issue in writing to the Owner as a condition precedent to final payment a "General Warranty" reflecting the terms and conditions of Sections 3.5.2 and 3.5.3 for all Work under the Contract Documents. This General Warranty shall be assignable. Submittal of all warranties and guarantees are required as a prerequisite to the final payment.

§ 3.5.7 Except when a longer warranty time is specifically called for in the Specification Sections or is otherwise provided by law, the General Warranty shall be for twelve (12) months and shall be in form and content otherwise satisfactory to the Owner. Contractor acknowledges that the Project may involve construction work on more than one (1) building for the Owner. Each building, or approved phase of each building, may have its own, separate, and independent date of Substantial Completion or Final Completion. Contractor shall maintain a complete and accurate schedule of the dates of Substantial Completion, dates upon which the one (1) year warranty on each phase or building which is substantially complete will expire, and dates of Final Completion. Contractor agrees to provide notice of the warranty expiration date to Owner and Architect at least one (1) month prior to the expiration of the one (1) year warranty period on each building or each phase of the building which has been substantially completed. Prior to termination of the one (1) year warranty period, Contractor shall accompany the Owner and Architect on reinspection of the building and be responsible for correcting any reasonable additional deficiencies not caused by the Owner or by the use of the building which are observed or reported during the reinspection. For extended warranties required by various sections, i.e., roofing, compressors, mechanical equipment, Owner will notify the Contractor of deficiencies and Contractor shall start remedying these defects within three (3) days of initial notification from Owner. Contractor shall prosecute the Work without interruption until accepted by the Owner and the Architect, even though such prosecution should extend beyond the limit of the warranty period. If Contractor fails to provide notice of the expiration of the one (1) year warranty period at least one (1) month prior to the expiration date, Contractor's warranty obligations described in this Section shall continue until such inspection is conducted and any deficiencies found in the inspection corrected.

§ 3.5.8 Warranties shall become effective on a date established by the Owner and Architect in accordance with the Contract Documents. This date shall be the date of Substantial Completion of the entire Work, unless otherwise provided in any Certificate of Partial Substantial Completion approved by the parties, except for Work to be completed or corrected after the date of Substantial Completion and prior to final payment. Warranties for Work to be completed or corrected after the date of Substantial Completion and prior to final payment shall become effective on the later of the date the Work is completed or corrected and accepted by the Owner and Architect or the date of final payment.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.
§ 3.6.1 The Contractor may not include in the Contract Price or any Modification any amount for sales, use, or similar taxes for which (1) a Texas independent school district is exempt, and (2) the Owner has provided the Contractor with a tax exemption certificate or other documentation necessary to establish the Owner's exemption from such taxes.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work. In performing its obligations hereunder, the Contractor shall fully comply with all applicable laws, ordinances, rules, regulations,

lawful orders and decrees of all applicable authorities, and when requested shall furnish evidence satisfactory to the owner of such compliance.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction. The Contractor agrees to indemnify, defend and hold harmless the Owner, its trustees, officers, representatives, agents and employees from and against all claims, fines, penalties, or liabilities from or arising out of such Work, or based upon the actual or asserted violation of any laws, ordinances, rules, regulations, orders or decrees applicable to such Work.

§ 3.7.4 Concealed or Unknown Conditions

~~If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.~~

§ 3.7.4 Concealed or Unknown Conditions, Claims for Concealed or Unknown Conditions

Contractor acknowledges that there may exist at the Project site certain soil and geological conditions and/or surface physical conditions which are not disclosed in the Contract Documents, and which have been known to or may be reasonably anticipated to occur in the area or be related to any past use of the Project site, including, without limitation, the presence of rock and its hardness, geologic formations, differing soils, and surface structures, equipment or other impediments, either natural or man-made (collectively, "Subsurface Conditions"). Owner makes no representations or warranties regarding Subsurface Conditions at the Project site, or of the accuracy or continuity of conditions which may be noted in any reports furnished or made available to Contractor. Contractor covenants and agrees that any such reports are furnished or made available by Owner to Contractor for information purposes only, and Contractor acknowledges that Owner is not responsible for the content thereof. Contractor shall be responsible for inspecting the site and determining the existence or likelihood of any Subsurface Conditions which may affect the Contract Time or the Contract sum, or both. The Contract Time and the Contract Sum bid by Contractor shall be deemed to include all costs of and time to complete all Work associated with or attributable to Subsurface Conditions, and Contractor shall not be entitled to submit a claim for or to obtain an extension of the Contract Time or increase in the Contract Sum due to the existence of Subsurface Conditions. Except as provided above with respect to Subsurface Conditions, if conditions are encountered at the site which are concealed physical conditions which were not known to the Contractor and which differ substantially from those indicated in the Contract Documents, then the Contractor shall notify the Owner and the Architect of such conditions promptly before conditions are disturbed, and in no event less than three (3) days after first observation of the conditions. The Architect will promptly investigate such conditions and report its findings to the Owner. If the Owner and the Contractor cannot agree on an adjustment to the Contract Sum or Contract Time, the adjustment shall be subject to mediation pursuant to Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract ~~Sum and Contract~~ Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.7.6 The Contractor shall also obtain all permits and approvals, and pay all fees and expenses, if any, associated with National Pollutant Discharge Elimination System (NPDES) regulations administered by the Environmental Protection Agency (EPA) and local authorities, if applicable, that require completion of documentation and/or acquisition of a "Land Disturbing Activities Permit" for the Project. Contractor's obligations under this Section do not require it to perform engineering services during the pre-construction phase to prepare proper drainage for the construction sites. However, any drainage alterations made by Contractor during the construction process which require the issuance of a permit shall be at Contractor's sole cost.

3.7.7 The Contractor shall certify in writing that no materials used in the Work contain lead or asbestos materials in them in excess of amounts allowed by Local/State standards, laws, codes, rules and regulations; the Federal Environmental Protection Agency (EPA) standards and/or the Federal Occupational Safety and Health Administration (OSHA) standards, whichever is most restrictive. The Contractor shall provide this written certification as part of submittals under the Section in the Instruments of Service related to Contract Closeout.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, ~~profit,~~ profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under ~~Section 3.8.2.1~~ Section 3.8.2.1 and (2) changes in Contractor's costs under ~~Section 3.8.2.2~~ Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner ~~with reasonable promptness,~~ within such time as is reasonably specified by the Contractor as necessary to avoid delay in the Work.

3.8.4 When performing Work under allowances, where reasonably possible, Contractor shall solicit and receive no fewer than three (3) written proposals and shall provide the Work as directed by the Architect, upon Owner's written approval, on the basis of the best value for the Owner.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. The Contractor shall not replace the Superintendent prior to Final Completion of the Work unless (1) the Superintendent shall cease to be employed by the Contractor or its subsidiaries or affiliated companies, or (2) the Owner agrees to such replacement. The Superintendent may not be employed on any other project prior to Final Completion of the Work. From Substantial Completion to Final Completion, the Superintendent shall be on-site as necessary to ensure that Final Completion occurs within thirty (30) days of Substantial Completion.

~~§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.~~ Contractor shall furnish a list to the Architect of all engineers, consultants, job-site superintendents, Subcontractors and suppliers involved in construction. The Architect shall provide such information to the Owner.

- .1 The Owner may reject or require removal of any engineer, consultant, job superintendent, or employee of the Contractor, Subcontractor or Sub-subcontractor involved in the Project.

- .2 Contractor shall provide an adequate staff for the proper coordination and expedition of the Work. Owner reserves the right to require Contractor to dismiss from the Work any employee or employees that Owner may deem incompetent, careless, insubordinate, or in violation of any provision in these Contract Documents. This provision is applicable to Subcontractors, Sub-subcontractors and their employees.
- .3 The Owner reserves the right to utilize one or more of its employees to function in the capacity of the Owner's inspector, whose primary function will be daily inspections, checking pay requests, construction timelines, and storage of supplies and materials.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed. Owner shall be notified not less than twenty-four (24) hours before any time that superintendent will not be present at the site for any reason except illness. If the reason is due to illness, then Owner shall be notified at the beginning of that day. Owner shall be notified of the identity of the acting superintendent. In the event the superintendent is absent from the site and notice has not been provided nor has an acting superintendent been assigned to the Work, the Contractor is subject to being back charged in the amount of TWO HUNDRED FIFTY AND NO/100 DOLLARS (\$250.00) for each day.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project. Contractor's initial construction schedule for the Work utilizing critical path method scheduling techniques. The initial schedule shall not exceed the time limits set forth in the Contract Documents. The initial schedule shall thereafter be updated on a monthly basis and submitted with each application for payment. The receipt of an updated schedule with each application for payment shall be a condition precedent to the Owner's duty to make any payment pursuant to Article 9.6.

- .1 Each schedule shall break the Work into a sufficient number of activities to facilitate the efficient use of critical path method scheduling by the Contractor, Owner, and Architect. Each schedule activity shall be assigned a cost value consistent with the Schedule of Values so as to allow the Owner and Contractor to project cash flow for the Project.
- .2 Each schedule shall include activities representing manufacturing, fabrication, or ordering lead time for materials, equipment, or other items for which the Architect is required to review submittals, shop drawings, product data, or samples.
- .3 Each schedule, other than the initial schedule, shall indicate the activities, or portions thereof, which have been completed; shall reflect the actual time for completion of such activities; and shall reflect any changes to the sequence or planned duration of all activities.
- .4 If any updated schedule exceeds the time limits set forth in the Contract Documents for completion of the Work, the Contractor shall include with the updated schedule a statement of the reasons for the anticipated delay in completion of the Work and the Contractor's planned course of action for completing the Work within the time limits set forth in the Contract Documents. If the Contractor asserts that the failure of the Owner or the Architect to provide information to the Contractor is the reason for anticipated delay in completion, the Contractor shall also specify what information is required from the Owner or Architect.
- .5 Neither the Owner or the Contractor shall have exclusive ownership of float time in the schedule, and all float time shall inure to the benefit of the Project. The Contractor agrees to use its best efforts not to sequence the Work or assign activity durations so as to produce a schedule in which more than one-fourth of the remaining activities have no float time.
- .6 Submission of any schedule under this Contract constitutes a representation by the Contractor that: (1) the schedule represents the sequence in which the Contractor intends to prosecute the remaining Work; (2) the schedule represents the actual sequence and durations used to prosecute the completed Work; (3) that to the best of its knowledge and belief the Contractor is able to complete the remaining Work in the sequence and time indicated; and, (4) that the Contractor intends to complete the remaining

Work in the sequence and time indicated.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 ~~The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.~~ Upon review and acceptance by the Owner and the Architect of the Milestone Dates, the construction schedule shall be deemed part of the Contract Documents. If not accepted, the construction schedule shall be promptly revised by the Contractor in accordance with the recommendations of the Owner and the Architect and resubmitted for acceptance. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays. The accepted construction schedule shall be updated to reflect actual conditions. In the event any progress report indicates any delays, the Contractor shall propose an affirmative plan to correct the delay, including overtime and/or additional labor, if necessary. In no event shall any progress report constitute an adjustment in the Contract Time, any Milestone Date, or the Contract Sum unless any such adjustment is agreed to by the Owner and authorized pursuant to Change Order.

§ 3.10.4 In the event the Owner determines that the performance of the Work has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitations, (i) working additional shifts of overtime, (ii) supplying additional manpower, equipment and facilities, and (iii) other similar measures (hereinafter referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule.

- .1 The Contractor shall not be entitled to an adjustment in the Contract Sum in connection with Extraordinary Measures required by the Owner under or pursuant to this Subparagraph 3.10.5.
- .2 The Owner may exercise the rights furnished the Owner under or pursuant to this Subparagraph 3.10.5 as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

§ 3.10.5 If reasonably required by Owner, Contractor shall also prepare and furnish project cash flow projections, manning data for critical activities, and schedules for the purchase and delivery of all critical equipment and material, together with periodic updating thereof.

§ 3.10.6 The Contractor shall recommend to the Owner and to the Architect a schedule for procurement of long-lead time items which will constitute part of the Work as required to meet the Project schedule. If such long-lead time items are procured by the Owner, they shall be procured on terms and conditions as recommended by the Contractor. Upon the Owner's acceptance of the Contractor's Stipulated Sum proposal, all contracts previously entered into by Owner shall be assigned by Owner to the Contractor who shall accept responsibility for such contracts as if it had initially entered into such contracts. Contractor shall expedite the delivery of long-lead time items. The Contractor shall receive and protect all Owner supplied material.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.11.1 Contractor shall make available, at the Project site, job records, including, but not limited to, invoices, payment records, payroll records, daily reports, logs, diaries, and job meeting minutes, applicable to the Project. Contractor shall make such reports and records available to inspection by the Owner, Architect, or their respective agents.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy not be responsible for the adequacy of the performance and design criteria provided specified in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

3.12.10.3 The Architect's review of Contractor's submittals will be limited to one examination of an initial submittal and one (1) examination of a resubmittal. The Architect's review of additional submittals will be made only with the consent of the Owner after notification by the Architect. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for evaluation of such additional resubmittals.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment. **§ 3.13.1** The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment. The Contractor shall so conduct its operations as not to unreasonably interfere with traffic on public thoroughfares adjacent or near to the Project site.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

3.14.3 No cutting of structural elements will be permitted unless specifically approved in writing by Owner.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. Contract and shall, not less than two times each week, clean up by removing rubbish, including old and surplus materials. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project materials, and shall clean, sweep, mop, brush and polish, as appropriate, the interior of the improvements or renovated areas, including but not limited to, any floors, carpeting, ducts, fixtures, and ventilation units operated during construction. Contractor shall clean exterior gutters, drainage, walkways, driveways and roofs of debris.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.15.3 The Contractor shall be responsible for the protection of the Work. Prior to the Architect's inspection for Substantial Completion, the Contractor shall clean exterior and interior surfaces exposed to view; remove temporary labels, stains, putty, soil, paint and foreign substances from all surfaces, including glass and painted surfaces; polish transparent and glossy surfaces; clean equipment and fixtures to a sanitary condition; replace air filters in mechanical equipment; clean roofs, gutters, and downspouts; remove obstructions and flush debris from drainage systems; clean site; sweep paved areas, and rake clean other surfaces; remove trash and surplus materials from the site; clean and polish all floors; clean and polish all hardware; and repair all Work damaged during cleaning.

3.15.4 After construction is complete, Contractor shall: (1) employ skilled workers for final cleaning; (2) remove grease, mastic adhesive, dust, dirt, stains, fingerprints, labels and other foreign materials from all sight-exposed interior and exterior surfaces; (3) wash and shine glazing and mirrors; (4) polish glossy surfaces to a clear shine; (5) vacuum clean carpet and similar soft surfaces; (6) clean (damp mop with clean mop and water) resilient and hard surface floors, repeating as necessary until no visible residue remains on floors; (7) clean plumbing fixtures to a sanitary condition; (8) clean surfaces of all equipment and remove excess lubrication; (9) clean permanent filters and replace disposable filters in ventilating system if units are operated during construction and clean ducts, blowers, and coils; (10) clean light fixtures; (11) remove waste, foreign matter, and debris from roofs, gutters, area ways, and drainage ways; (12) remove waste, debris, and surplus materials from the site; (13) remove stains, spills, and foreign substances from paved areas; and (14) broom clean exterior concrete and paved surfaces, and rake clean the grounds.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 ~~To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.~~ TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR WAIVES AND RELEASES ALL CLAIMS AGAINST AND SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS THE OWNER, OWNER'S CONSULTANTS, THE ARCHITECT, THE ARCHITECT'S CONSULTANTS, AND THEIR RESPECTIVE AGENTS AND EMPLOYEES FROM AND AGAINST ALL CLAIMS, DAMAGES, LOSSES, AND EXPENSES, INCLUDING ATTORNEY'S FEES, ARISING OUT OF, OR RESULTING FROM THE PERFORMANCE OF THE WORK, PROVIDED THAT ANY SUCH CLAIM, DAMAGE, LOSS OR EXPENSE: (1) IS ATTRIBUTABLE TO BODILY OR PERSONAL INJURY, SICKNESS, DISEASE OR DEATH, OR TO INJURY TO OR DESTRUCTION OF TANGIBLE PROPERTY (OTHER THAN THE WORK ITSELF) INCLUDING THE LOSS OF USE RESULTING THEREFROM, AND (2) IS CAUSED IN WHOLE OR IN PART BY ANY WILLFUL OR NEGLIGENT ACT OR OMISSION OF THE CONTRACTOR, ANY

SUBCONTRACTOR, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY ANY OF THEM OR ANYONE FOR WHOSE ACTS ANY OF THEM MAY BE LIABLE, REGARDLESS OF WHETHER OR NOT CAUSED IN PART BY THE NEGLIGENT ACTS OR OMISSIONS OF OWNER, OWNER'S CONSULTANTS, THE ARCHITECT AND THE ARCHITECT'S CONSULTANTS, WHERE THAT NEGLIGENCE IS A CONCURRING CAUSE OF THE INJURY, DEATH, OR DAMAGE. HOWEVER, THE INDEMNITY PROVIDED FOR IN THIS SECTION SHALL HAVE NO APPLICATION TO ANY CLAIM, LOSS, DAMAGE, CAUSE OF ACTION, SUIT, OR LIABILITY WHERE THE INJURY, DEATH, OR DAMAGE RESULTS FROM THE SOLE NEGLIGENCE OF OWNER, OWNER'S CONSULTANTS, ARCHITECT OR ARCHITECT'S CONSULTANTS UNMIXED WITH THE FAULT OF ANY OTHER PERSON OR ENTITY; PROVIDED THAT WHERE THE NEGLIGENCE OF OWNER, OR ARCHITECT IS A CONCURRING CAUSE, CONTRACTOR'S OBLIGATION TO INDEMNIFY IS LIMITED TO THE AMOUNT NECESSARY TO CAUSE THE RELATIVE LIABILITY OF OWNER, ARCHITECT AND CONTRACTOR TO REFLECT THE COMPARATIVE NEGLIGENCE FINDINGS OF THE TRIER OF FACT (JUDGE OR JURY) OR AS AGREED IN A SETTLEMENT AGREEMENT TO WHICH OWNER, ARCHITECT AND CONTRACTOR ARE ALL PARTIES.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts. IN CLAIMS AGAINST ANY PERSON OR ENTITY INDEMNIFIED UNDER THIS SECTION 3.18 BY AN EMPLOYEE OF THE CONTRACTOR, A SUBCONTRACTOR, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY THEM OR ANYONE FOR WHOSE ACTS THEY MAY BE LIABLE, THE INDEMNIFICATION OBLIGATION UNDER THIS SECTION 3.18 SHALL NOT BE LIMITED BY A LIMITATION ON AMOUNT OR TYPE OF DAMAGES, COMPENSATION OR BENEFITS PAYABLE BY OR FOR THE CONTRACTOR OR A SUBCONTRACTOR UNDER INSURANCE POLICIES, WORKERS' COMPENSATION ACT OR INSURANCE, DISABILITY ACTS OR INSURANCE OR OTHER EMPLOYEE BENEFIT ACTS OR RELATED INSURANCE.

3.18.3 CONTRACTOR SHALL BE RESPONSIBLE FOR AND SHALL HOLD OWNER, OWNER'S CONSULTANTS, ARCHITECT OR ARCHITECT'S CONSULTANTS FREE AND HARMLESS FROM LIABILITY RESULTING FROM LOSS OF OR DAMAGE TO CONTRACTOR'S OR ITS SUBCONTRACTORS' CONSTRUCTION TOOLS AND EQUIPMENT AND RENTED ITEMS WHICH ARE USED OR INTENDED FOR USE IN PERFORMING THE WORK, REGARDLESS OF WHETHER SUCH LOSS OR DAMAGE IS CAUSED IN WHOLE OR IN PART BY THE NEGLIGENCE OF OWNER, OWNER'S CONSULTANTS, ARCHITECT OR ARCHITECT'S CONSULTANTS. THIS PROVISION SHALL APPLY, WITHOUT LIMITATION, TO LOSS OR DAMAGE OCCURRING AT THE WORK SITE OR WHILE SUCH ITEMS ARE IN TRANSIT TO OR FROM THE WORK SITE AND IS IN ADDITION TO CONTRACTOR'S OBLIGATIONS UNDER SECTION 3.18.1. IT IS THE EXPRESS INTENTION OF THE PARTIES HERETO, BOTH CONTRACTOR AND OWNER, THAT THE INDEMNITY IS PROVIDED FOR IN THIS SECTION AS TO CONTRACTOR'S OR ITS SUBCONTRACTOR'S TOOLS AND EQUIPMENT AND RENTAL ITEMS, IS AN AGREEMENT BY CONTRACTOR TO INDEMNIFY AND PROTECT OWNER FROM THE CONSEQUENCES OF OWNER'S OWN NEGLIGENCE, AND THAT OF OWNER'S CONSULTANTS, THE ARCHITECT AND ARCHITECT'S CONSULTANTS WHETHER THAT NEGLIGENCE IS THE SOLE OR CONCURRING CAUSE OF THE LOSS OR DAMAGE. PROVIDED HOWEVER, THAT WHERE THE NEGLIGENCE OF OWNER OR ARCHITECT IS A CONCURRING CAUSE, CONTRACTOR'S OBLIGATION TO INDEMNIFY IS LIMITED TO THE AMOUNT NECESSARY TO CAUSE THE RELATIVE LIABILITY OF OWNER, ARCHITECT AND CONTRACTOR TO REFLECT THE COMPARATIVE NEGLIGENCE FINDINGS OF TRIER OF FACT (JUDGE OR JURY) OR AS AGREED IN A SETTLEMENT AGREEMENT TO WHICH OWNER, ARCHITECT AND CONTRACTOR ARE ALL PARTIES.

3.18.4 Indemnification hereunder shall include, without limiting the generality of the foregoing, liability which could arise to the Owner, its agents, consultants, and representatives or the Architect pursuant to State statutes for the safety of workmen and in addition, all Federal statutes and rules existing thereunder for protection, occupational safety and health to workmen. It being agreed that the primary obligation of the Contractor is to comply with said statutes in performance of the Work by Contractor and that the obligations of the Owner, its agents, consultants, and representatives under said statutes are secondary to that of the Contractor.

3.18.5 THE PROVISIONS OF ARTICLE 3.18 IN ITS ENTIRETY SHALL SURVIVE THE COMPLETION, TERMINATION OR EXPIRATION OF THIS CONTRACT.

§ 3.19 REPRESENTATIONS AND WARRANTIES

§ 3.19.1 The Contractor represents and warrants the following to the Owner (in addition to the other representations and warranties contained in the Contract Documents), as an inducement to the Owner to execute this Contract, which representations and warranties shall survive the execution and delivery of the Contract and the Final Completion of the Work:

- .1 that it is financially solvent, able to pay its debts as they mature and possessed of sufficient working capital to complete the Work and perform its obligations under the Contract Documents;
- .2 that it is able to furnish the plant, tools, materials, supplies, equipment and labor required to complete the Work and perform its obligations hereunder and has sufficient experience and competence to do so;
- .3 that it is authorized to do business in the State where the Project is located and properly licensed by all necessary governmental and public quasi-public authorities having jurisdiction over it and over the Work and the site of the Project;
- .4 that the execution of the Contract and its performance thereof is within its duly authorized powers; and
- .5 that its duly authorized representative has visited the site of the Work, familiarized itself with the local conditions under which the Work is to be performed and correlated its observations with the requirements of the Contract Documents.

§ 3.20 BUSINESS STANDARDS

§ 3.20.1 Contractor, in performing its obligations under Contract, shall establish and maintain appropriate business standards, procedures, and controls, including those necessary to avoid any real or apparent impropriety or adverse impact on the interest of Owner or affiliates. Contractor shall review, with Owner, at a reasonable frequency during the performance of the Work hereunder, such business standards and procedures including, without limitation, those related to the activities of Contractor's employees and agents in their relations with Owner's employees, agents, and representatives, vendors, Subcontractors, and other third parties, and those relating to the placement and administration of purchase orders and contracts.

§ 3.21 ANTITRUST VIOLATION

§ 3.21.1 To permit the Owner to recover damages suffered in antitrust violations, Contractor hereby assigns to Owner any and all claims for overcharges associated with this Contract which violate the antitrust laws of the United States, 15 U.S.C.A., Sec. 1 et seq. The Contractor shall include this provision in its agreements with each subcontractor and supplier. Each subcontractor shall include such provisions in agreements with sub-subcontractor and suppliers.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

~~§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.~~ Intentionally deleted.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the ~~Architect issues the final Certificate for Payment.~~ Owner's contract with the Architect terminates. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or

procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. Neither the Owner nor Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect or the Owner has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect or the Owner considers it necessary or advisable, the Architect or the Owner will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect or the Owner nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect or the Owner to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work. Certain portions of the Work will be tested and/or observed at various stages, sometimes off the Project site, between initial observation or review and final positioning of the completed Work. Nothing in any initial or prior approval or test result shall govern if at any subsequent time the Work or any portion thereof is found not to conform to the requirements of the Contract Documents.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component. If any submittal does not comply with the requirements of the Contract Documents, the Architect shall require Contractor to come into compliance. The Architect shall promptly report in writing to the Contractor and Owner any errors, inconsistencies and omissions discovered by the Architect in the Shop Drawings, Product Data and Samples, so as to keep from delaying the Work or the activities of the Owner, Contractor or other Contractors.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 ~~The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. Upon written request of the Owner or Contractor, the Architect will issue its interpretation of the requirements of the plans and specifications.~~ The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. ~~When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.~~

§ 4.2.13 The ~~Architect's~~ Owner's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract ~~Documents.~~ Documents and not expressly overruled in writing by the Owner.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for ~~information.~~ information at no additional expense to the Owner.

4.2.15 The Architect may appoint an employee or other person to assist the Architect during the construction. These representatives will be instructed to assist the Contractor in interpreting the Contract Documents; however, such assistance shall not relieve the Contractor from any responsibility as set forth by the Contract Documents. The fact that the Architect's Representative may have allowed Work not in accordance with the Contract Documents shall not prevent the Architect from insisting that the faulty Work be corrected to conform to the Contract Documents and the Contractor shall correct same

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, actually and directly occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.3.1 Neither the Owner nor the Architect shall be obligated to pay or to insure the payment of any monies to Subcontractors or vendors by the Contractor.

§ 5.3.2 The Contractor shall require any potential Subcontractor to disclose to the Contractor any ownership interest or familial relationship between the Contractor, the Architect or the Owner and the potential Subcontractor prior to entering into a contract. Contractor shall report to Owner all such disclosures and the Owner shall have the right, in its sole discretion, to reject any such affiliated Subcontractor.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 — assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 — assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity,

~~the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.~~

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation may, in the Owner's sole discretion, be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this ~~Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.~~Contract.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. ~~The Upon written approval by Owner and Architect, the~~ Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules so approved by Owner shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect and Owner of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. ~~The Contractor shall not be responsible~~

~~for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.~~

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.1.4 On Change Orders and Construction Change Directives, the total Contractor mark-up for overhead and profit included in the total cost to the Owner shall be based upon the following schedule:

- .1 For the Contractor, for Work performed by the Contractor's own forces, ten percent (10% of the cost (0% for change orders to be paid out of any contingency allowance).
- .2 For the Contractor, for the Work performed by the Contractor's Subcontractors, four percent (4%) of the amount due the Subcontractors (0% for the change orders to be paid out of any contingency allowance).
- .3 For each Subcontractor or Sub-subcontractor involved, for Work performed by that Subcontractor's or Sub-subcontractor's own forces, ten percent (10%) of the cost.
- .4 The costs to which the above percentages shall be applied will be determined in accordance with Section 7.3.8.
- .5 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including quantities and unit costs of labor and materials extended and totaled.
- .6 By Unit Prices stated in the Contract Documents or subsequently agreed upon. Additional mark-ups for overhead and profit will not be allowed in Unit Price work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument ~~prepared by the Architect and signed by the Owner, Contractor, and Architect~~ initiated by the Owner and signed by the Owner and the Contractor for the reasons set forth in Subsection 8.2.2 and stating their agreement upon all of the following:

- .1 The change in the Work;

- .2 The amount of the adjustment, if any, ~~in to~~ the Contract Sum; and
- .3 The extent of ~~the adjustment, if any, in the Contract Time~~ adjustment, if any, to the Contract Time.

§ 7.2.2 Acceptance of a disbursement from any allowance fund, contingency fund or acceptance of a Change Order by the Contractor shall constitute full accord and satisfaction for any and all claims, whether direct or indirect, including but not limited to impact, delay or acceleration damages, arising from the subject matter of the disbursement or Change Order.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount Section 7.1.4. In such case, and also under Section 7.3.3.3, Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect and the Owner may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and applicable sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change the change only if the adjustment causes an extension of the Contract Time.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect, plus overhead and profit as set forth in Section 7.1.4. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement shall be the first business day following the Contractor's written notice to proceed. The notice to proceed shall not be issued until the Agreement has been signed by the Contractor and the Owner, the Owner and Architect have received and approved as to form all required payment and performance bonds and insurance as required by Article 11.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8. Section 9.8.

8.1.3.1 The date of Final Completion is the date certified by the Architect in accordance with Section 9.10. Unless otherwise agreed in writing by Owner, Contractor agrees that Final Completion shall occur not more than thirty (30) days after the date of Substantial Completion.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner. Contractor. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

8.2.4 In the event Substantial Completion or Final Completion are not achieved by the designated dates, or as the dates may be extended, Owner may withhold payment of any further sums due until Substantial Completion and/or Final Completion are achieved. Owner shall also be entitled to deduct out of any sums due to Contractor any or all liquidated damages due Owner in accordance with the Contract Documents.

8.2.5 If the Contractor fails to achieve Substantial Completion of the Work within the Contract Time and Final Completion in accordance with the timeline set forth in the Agreement, the Owner shall be entitled to retain or recover from the Contractor and the Contractor's surety, as liquidated damages and not as a penalty, the per diem amounts set forth in Section 4.5 of the AIA A101, commencing upon the first day following expiration of the Contract Time and continuing until the actual Date of Substantial Completion and/or beginning upon Substantial Completion and continuing until Final Completion is achieved. Such liquidated damages are hereby agreed to be a reasonable estimate of damages the Owner will incur as a result of delayed completion of the Work.

8.2.6 If one or more of the Liquidated Damages provisions set out in the Agreement are held to be legally unenforceable as a penalty (except when the holding is the result of a challenge by the Owner), the Owner shall be allowed to recover actual damages caused by the Contractor's failure to achieve the applicable Contract Time requirements.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine. The Owner, except as provided for in this Section 8.3.1, shall not be liable to the Contractor for delay to the Contractor's Work by the act, neglect or default of the Owner or the Architect, or by reason of fire, act of God, riot, strike, action of workmen or others, or any cause beyond the Owner's control. Should the Owner or Architect delay the Contractor in the Work, Contractor shall receive an extension of time for completion equal to the delay if a written claim is made within forty-eight (48) hours, and under no circumstances shall the Owner be liable to pay the Contractor any compensation for such Owner-caused delays.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3-Agreement does not preclude-permit recovery of damages for delay by either party under other provisions of the Contract Documents, the Contractor for delay, disruption or acceleration. Contractor agrees that Contractor shall be fully compensated for all delays solely by an extension of time.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents. All costs of overtime Work required by the Contract Time and the nature of the Work, as set forth in or inferable from the Contract Documents, except costs of emergencies covered in Section 10.4, shall be and are included in the Contract.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to

~~substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.~~ § 9.2.1 Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect or the Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

~~§ 9.3.1 At least ten days before the date established for each progress payment, In accordance with the requirements of Section 5.1.3 of the Agreement,~~ the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under ~~Section 9.2, Section 9.2,~~ for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect ~~retainage if provided for in the Contract Documents,~~ other data as reasonably requested by Owner or Architect. The form of Application for Payment, duly notarized, shall be a current authorized edition of AIA Document G702-1992, Application and Certificate for Payment, supported by a current authorized edition of AIA Document G703-1992, Continuation Sheet.

§ 9.3.1.1 As provided in ~~Section 7.3.9, Section 7.3.9,~~ such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

~~9.3.1.3 Contractor agrees that, for purposes of Texas Government Code section 2251.042, receipt of the Application for Payment by the Architect shall not be construed as receipt of an invoice by the Owner. Contractor further agrees that Owner's receipt of the Architect's Certificate for Payment shall be construed as a receipt of an invoice by the Owner, for purposes of Texas Government Code section 2251.042.~~

~~§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site. Except as otherwise agreed in writing, executed by the Owner and Contractor prior to delivery of material and equipment, the Contractor is not entitled to payment for material and equipment delivered and stored on site or off site. The Owner may, in the Owner's sole discretion, agree to make payment for materials stored on site or off site and may, as a condition precedent to the grant of such consent, establish reasonable procedures and requirements (including provision of additional insurance at Contractor's sole expense) with which Contractor must comply.~~

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work. CONTRACTOR SHALL INDEMNIFY AND HOLD OWNER HARMLESS FROM ANY LIENS, CLAIMS, SECURITY INTERESTS OR ENCUMBRANCES

FILED BY THE CONTRACTOR, SUBCONTRACTORS, OR ANYONE CLAIMING BY, THROUGH OR UNDER THE CONTRACTOR OR SUBCONTRACTOR FOR ITEMS COVERED BY PAYMENTS MADE BY THE OWNER TO CONTRACTOR.

9.3.4 In each Request for Payment, Contractor shall certify that there are no known mechanics' or materialmen's liens outstanding at the date of this requisition, that all due and payable bills with respect to the Work have been paid to date or are included in the amount requested in the current application and that except for such bills not paid but so included, there is no known basis for the filing of any mechanics' or materialmen's liens on the Work, and that releases from all contractors and materialmen have been obtained in such form as to constitute an effective release of lien under the laws of the State of Texas covering all Work theretofore performed and for which payment has been made by Owner to Contractor.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect or the Owner may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 ~~Section 9.4.2~~ cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. ~~Section 9.4.1~~. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect or Owner may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's or Owner's opinion to protect the Owner from loss for which the Contractor is responsible, including including, but not limited to, loss resulting from acts and omissions described in Section 3.3.2, ~~because of Section 3.3.2, because of~~:

- .1 defective-Defective Work not remedied;
- .2 third-Third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure-Failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable-Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage-Damage to the Owner or a Separate Contractor;

- ~~.6 reasonable~~ Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; ~~or~~
- ~~.7 repeated~~ Repeated failure to carry out the Work in accordance with ~~the Contract Documents. the~~ Contract Documents;
- ~~.8 Delay beyond the times set forth elsewhere in the Contract Documents including but not limited to the submission for approval of the schedule of values, cost breakdowns on proposal requests, progress schedule, list of Subcontractors and insurance requirements;~~
- ~~.9 Evidence of financial inability to perform the Contract fully;~~
- ~~.10 Failure to submit record documents required by the Contract; or~~
- ~~.11 Failure of the Contractor to perform any other obligations of the Contract.~~

§ 9.5.2 ~~When either party disputes the Architect's~~ If the Contractor disputes the Architect's or the Owner's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, ~~that party the Contractor~~ the Contractor may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld. The Owner shall not be deemed in default by reason of withholding payment as provided for in Section 9.5.1.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued and the Owner has approved a Certificate for Payment, the Owner shall make payment of undisputed amounts in the manner and within the time provided in the Contract Documents, and shall so notify the Architect. Owner shall notify Contractor within twenty-one (21) days if Owner disputes the Architect's Certificate for Payment, pursuant to Texas Government Code section 2251.042 et. seq., listing the specific reasons for nonpayment. Payments to the Contractor shall not be construed as releasing the Contractor or his Surety from any obligations under the Contract Documents.

§ 9.6.2 The Contractor ~~shall pay each Subcontractor, no later than seven days after shall, within ten (10) days following receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner pay all undisputed bills for labor and materials performed and furnished by others in connection with the construction, furnished and equipping of the improvements and the performance of the Work, and shall, if requested, provide the Owner with evidence of such payment. Contractor's failure to make payments within such time shall constitute a material breach of this contract. Contractor shall include a provision in each of its contracts imposing the same payment obligations on its Subcontractors as are applicable to the Contractor hereunder. If the Contractor has failed to make payment promptly to the Contractor's Subcontractors or for materials or labor used in the Work for which the Owner has made payment to the Contractor, the Owner shall be entitled to withhold payment to the Contractor in part or in whole to the extent necessary to protect the Owner.~~

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an

obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 ~~Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision. The Contractor shall, as a condition precedent to any obligation of the Owner under the Contract Documents, provide to the Owner payment and performance bonds in the full penal amount of the Contract in accordance with Texas Government Code Chapter 2253.~~

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven (7) days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven (7) days after the date established in the Contract Documents, the amount certified by the Architect and approved by the Owner or awarded by binding dispute resolution, then the Contractor may, upon seven (7) additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended ~~appropriately~~ appropriately, and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended ~~use~~ use; provided, however, as a condition precedent to Substantial Completion, the Owner has received all certificates of occupancy and any other permits, approvals, licenses, and other documents from any governmental authority having jurisdiction thereof necessary for the beneficial occupancy of the Project (or if the same cannot be delivered for reasons not the fault or responsibility of the Contractor, nevertheless all Contractor's obligations necessary to the issuance of such certificates, permits, approvals, or licenses will have been performed.) Without limiting the foregoing, in general, the only remaining Work following Substantial Completion shall be minor in nature, so that the Owner could occupy the Project on that date and the completion of the Work by the Contractor would not materially interfere or hamper the Owner's normal business operations.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Should the Architect determine the Contractor's list of items to be completed or corrected lacks sufficient details or requires extensive supplementation, the list will be returned to the Contractor for revision, and inspection for determining the date of Substantial Completion will be delayed until the list submitted is reasonable representation of the Work to be done.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect and the Owner will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

- .1 If, in Architect's opinion during the inspection, the Project, or the designated portion thereof which Owner has agreed to accept separately, is not sufficiently complete to warrant inspection, or if the list of items to be completed or corrected is not sufficiently complete to warrant inspection, then Architect may terminate the inspection and notify the Contractor that the Project is not ready for inspection. If for such reasons, Architect is required to make additional inspections, the Owner may deduct the cost of Architect's additional services made necessary thereby from any payments due the Contractor. The Architect's compensation shall be determined in accordance with the applicable provisions of the Agreement between the Owner and Architect.
- .2 Except with the consent of the Owner, the Architect will perform no more than ONE (1) inspection to determine whether the Work has attained Substantial Completion in accordance with the Contract Documents. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect, Engineer, Consultant or service provider for any additional inspections.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.8.6 Retainage is not due to the Contractor until thirty-one (31) days after Final Completion of the Work as set out in Section 9.10. After the Certificate of Substantial Completion is accepted by the Owner, the Owner may, in its sole discretion and upon acceptance and consent of surety, make payment of retainage on all or a part of the Work accepted.

9.8.7 In order for the Project or a major portion thereof to be considered substantially complete, the following conditions must be met:

- .1 All inspections by governmental authorities having jurisdiction over the Project must have been finalized, any remedial work required by those authorities must have been completed, and Certificates of Occupancy and similar governmental approval forms must have been issued and copies delivered to the Owner and Architect.
- .2 All work, both interior and exterior, shall have been completed and cleaned except minor items which if completed after occupancy, will not, in the Owner's opinion, cause interference to the Owner's use of the building or any portion thereof. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.

9.8.8 The following items are a partial specific list of requirements, subject to supplementation by Owner and Architect, as applicable to the Project, that must be completed prior to established Substantial Completion:

- .1 All fire alarm system components must be completed and demonstrated to the Owner.
- .2 Local fire marshal approved certificate, or similar Certificate of Occupancy from the governing agency, must be delivered to the Owner.
- .3 All exterior clean-up and landscaping must be complete.
- .4 All final interior clean-up must be complete.
- .5 All HVAC air and water balancing must be complete.
- .6 All required commissioning must be complete.
- .7 All Energy Management Systems must be complete and fully operational and demonstrated to the Owner.
- .8 All communications equipment, telephone system, and P.A. systems must be complete and demonstrated to the Owner.
- .9 All final lockset cores must be installed and all final Owner directed keying completed.
- .10 All room plaques and exterior signage must be completed.
- .11 All Owner demonstrations must be completed including kitchen equipment, HVAC equipment, plumbing equipment, and electrical equipment.
- .12 A final certificate of occupancy must be signed by the Contractor and delivered to the Owner.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under ~~Section 9.8.2.~~ Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless ~~otherwise agreed upon,~~ expressly agreed upon in writing, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 ~~Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract~~ When all of the Work is finally completed and the Contractor is ready for a final inspection it shall notify the Owner and the Architect thereof in writing. Thereupon, the Architect and Owner will make final inspection of the Work and, if the Work is complete in full accordance with the Contract Documents and this Contract has been fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled certifying to the Owner that the Project is complete and the Contractor is entitled to the remainder of the unpaid Contract Price, less any amount withheld pursuant to this Contract. Except with the consent of the Owner, the Architect will perform no more than one (1) inspection to determine whether the Work has attained Final Completion in accordance with the Contract Documents. If the Architect is unable to issue its final Certificate for Payment and is required to repeat its final inspection of the Work, the Contractor shall bear the cost of such repeat final inspection(s) which cost may be deducted by the Owner from the Contractor's final payment.

§ 9.10.2 ~~Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills~~ The Contractor shall not be entitled to final payment unless and until it submits to the Architect its affidavit that the payrolls, invoices for materials and equipment, and other indebtedness/liabilities connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may have been fully paid or otherwise satisfied; releases and waivers of liens from all Subcontractors of the Contractor and of any and all other parties required by the Architect or the Owner; such other provisions as Owner may request; and consent of Surety to final payment. If any third party fails or refuses to provide a release of claims or waiver of lien as required by Owner, the Contractor shall furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees. discharge any such lien or indemnify the Owner from liability.

§ 9.10.3 ~~If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it~~ The Owner shall make final payment of all sums due the Contractor not more than thirty-one (31) days after the Architect's execution of a final Certificate for Payment. The Final Payment shall not constitute a waiver of Claims; any claims by the Owner.

§ 9.10.4 ~~The making of final payment shall constitute a waiver of Claims by the Owner except those arising from~~
~~1 — liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;~~
~~2 — failure of the Work to comply with the requirements of the Contract Documents;~~
~~3 — terms of special warranties required by the Contract Documents; or~~
~~4 — audits performed by the Owner, if permitted by the Contract Documents, after final payment.~~ Intentionally deleted.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

§ 9.11 AUDIT

§ 9.11.1 Contractor agrees to maintain adequate books, payrolls and records satisfactory to the Owner in connection with any and all Work performed hereunder. Contractor agrees to retain all such books, payrolls and records (including data stored in computer) for a period of not less than three (3) years after completion of the Work. At all reasonable times, Owner and its duly authorized representatives shall have access to all personnel of Contractor and all such books, payrolls and records, and shall have the right to audit same.

§ 9.12 In addition to any liquidated damages payable to the Owner by the Contractor, if: (1) the Architect is required to make more than one (1) inspection for Substantial Completion; (2) the Architect is required to make more than 1 inspection for Final Completion; or (3) the Work is not substantially complete within thirty (30) days after the date established for Substantial Completion in the Contract Documents; the Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for any additional inspections or services.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

§ 10.1.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

- .1 Contractor's employees, agents, and Subcontractors shall not perform any service for Owner while under the influence of alcohol or any controlled stance. Contractor, its employees, agents, and Subcontractors shall not use, possess, distribute, or sell illicit or unprescribed controlled drugs or drug paraphernalia, or misuse legitimate prescription drugs while performing the Work. Contractor, its employees, agents, and Subcontractors shall not use, possess, distribute, or sell alcoholic beverages while performing the Work.
- .2 Contractor has adopted or will adopt its own policy to assure a drug and alcohol-free work place while performing the Work.
- .3 Contractor will remove any of its employees from performing the Work any time there is suspicion of alcohol and/or drug use, possession, or impairment involving such employee, and at any time an incident occurs where drug or alcohol use could have been a contributing factor. Owner has the right to require Contractor to remove employees from performing the Work any time cause exists to suspect alcohol or drug use. In such cases, Contractor's employees may only be considered for return to work after the Contractor certifies as a result of a for-cause test, conducted immediately following removal that said employee was in compliance with this contract. Contractor will not use an employee to perform the Work who either refuses to take, or tests positive in, any alcohol or drug test.
- .4 Contractor will comply with all applicable federal, state, and local drug and alcohol related laws and regulations (e.g., Department of Transportation regulations, Department of Defense Drug-Free Workforce Policy, Drug-Free Workplace Act of 1988).
- .5 Owner has also banned the presence of all weapons on the Project site, whether the owner thereof has a permit for a concealed weapon or not.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to:

- .1 employees ~~on the Work~~ on the Work, school personnel, students and other persons on the Owner's premises and other persons who may be affected ~~thereby~~; which protection shall include the installation of fencing between the Work site and the occupied portion of a connecting or adjacent educational facility;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, athletic fields and tracks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards. The Contractor shall also be responsible, at the Contractor's sole cost and expense, for all measures necessary to protect any property adjacent to the Project and improvements therein. Any damage to such property or improvements shall be promptly repaired by the Contractor. Contractor shall provide reasonable fall protection safeguards and provide approved fall protection safety equipment for use by all exposed Contractor employees.

§ 10.2.4 When use or storage of ~~explosives or~~ other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified ~~personnel-personnel~~, and shall only conduct such activities after giving reasonable advance written notice of the presence or use of such materials, equipment or methods to Owner and Architect. The storage of explosives on Owner's property is prohibited. The use of explosive materials on Owner's property is prohibited unless expressly approved in advance in writing by Owner and Architect.

§ 10.2.5 ~~The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18. CONTRACTOR SHALL HOLD OWNER HARMLESS FROM LIABILITY RESULTING FROM LOSS OF OR DAMAGE TO ANY PROPERTY THAT IS ON OR OFF THE SITE AND/OR IN TRANSIT AS REFERRED TO IN CLAUSE 10.2.1.2 EVEN IF SUCH LOSS OR DAMAGE RESULTS FROM OWNER, OWNER'S CONSULTANT'S, OR ARCHITECT'S NEGLIGENCE. AS TO PROPERTY REFERRED TO IN CLAUSE 10.2.1.3, CONTRACTOR SHALL HOLD OWNER FREE AND HARMLESS FROM LIABILITY RESULTING FROM LOSS OF OR DAMAGE CAUSED IN WHOLE OR IN PART BY THE CONTRACTOR, ANY SUBCONTRACTOR, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY ANY OF THEM, ANYONE FOR WHOSE ACTS ANY OF THEM MAY BE LIABLE, REGARDLESS OF WHETHER OR NOT SUCH DAMAGE IS CAUSED IN PART BY THE NEGLIGENT ACTS OR OMISSIONS OF THE OWNER, OWNER'S CONSULTANTS OR ARCHITECT. THE FOREGOING OBLIGATIONS OF THE CONTRACTOR ARE IN ADDITION TO HIS OBLIGATIONS UNDER SECTION 3.18; PROVIDED THAT WHERE THE NEGLIGENCE OF OWNER OR ARCHITECT IS A CONCURRING CAUSE, CONTRACTOR'S OBLIGATION TO INDEMNIFY IS LIMITED TO THE AMOUNT NECESSARY TO CAUSE THE RELATIVE LIABILITY OF OWNER, ARCHITECT AND CONTRACTOR TO REFLECT THE COMPARATIVE NEGLIGENCE FINDINGS OF THE TRIER OF FACT (JUDGE OR JURY) OR AS AGREED IN A SETTLEMENT AGREEMENT TO WHICH OWNER, ARCHITECT AND CONTRACTOR ARE ALL PARTIES.~~

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

~~If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.~~

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 3 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter. No provision of the Contract Documents shall waive Owner's immunity under the Texas Tort Claims Act, Texas Civil Practice and Remedies Code, Chapter 101.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1

The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in

the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, ~~to~~ cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the ~~fullest extent permitted by law, extent permitted by the laws and Constitution of the State of Texas,~~ the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in ~~Section 10.3.1~~ Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity. Notwithstanding anything to the contrary contained in this Section 10.3.3, the agreement of the Owner to indemnify, defend and hold harmless the parties described in this Section shall not extend or apply to claims, damages, losses, expenses or liabilities related to, created or caused in whole or in part by a party indemnified hereunder; it being agreed and understood that the Owner and any party so indemnified shall each bear liability for its own negligent acts or omissions, and that such indemnity shall extend only to liability for the negligent acts and omissions of the Owner.

§ 10.3.4 The Owner shall not be responsible under this ~~Section 10.3~~ Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of a hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under ~~Section 10.3.1, Section 10.3.1,~~ except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 ~~If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.~~ Intentionally deleted.

§ 10.4 Emergencies

~~In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.~~ **§ 10.4.1** In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

~~§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished. Intentionally deleted.~~

~~§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage. Intentionally deleted.~~

§ 11.2 Owner's Insurance

~~§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. Intentionally deleted.~~

~~§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto. Intentionally deleted.~~

~~§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the~~

~~insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.~~Intentionally deleted.

§ 11.3 Waivers of Subrogation

~~§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.~~Intentionally deleted.

~~§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.~~

~~§ 11.3.2~~ Intentionally deleted.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

~~The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.~~Intentionally deleted.

§ 11.5 Adjustment and Settlement of Insured Loss

~~§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.~~Intentionally deleted.

~~§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.~~Intentionally deleted.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1. If a portion of the Work has been covered and the Architect has specifically requested to see such Work, or if any known deficiencies exist, or the Contract Documents specifically request inspection prior to its being covered, the Architect may request to see that Work and it shall be uncovered by the Contractor. If the Work is not in accordance with the Contract Documents, it must be corrected and covered at the expense of the Contractor. If the Work is according to the Contract Documents, the cost to restore cover on the Work is at the sole expense of the Contractor.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

12.2.2.4 Upon request by the Owner and prior to the expiration of one (1) year from the date of Substantial Completion, the Architect will conduct and the Contractor shall attend a meeting with the Owner to review the facility operations and performance.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this ~~Section 12.2~~ Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in ~~Section 12.2.2~~ Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.2.6 Contractor shall (i) re-execute any parts of the Work that fail to conform with the requirements of this Agreement that appear in the progress of the Work; (ii) remedy any defects in the Work due to faulty materials or workmanship which appear within a period of one (1) year from Substantial Completion of the Work hereunder, or within such longer period of time as may be set forth in the Drawings and Specifications or other Contract Documents; and (iii) replace, repair, or restore any parts of the Project or furniture, fixtures, equipment, or other items placed therein (whether by Owner or any other party) that are injured or damaged by any such parts of the Work that do not conform to the requirements of the Contract Documents or defects in the Work.

§ 12.2.7 The provisions of this Section 12.2 apply to Work done by Subcontractors of the Contractor as well as Work done directly by employees of the Contractor. The provisions of this Section 12.2.7 shall not apply to corrective work attributable solely to the acts or omissions of any separate contractor of Owner (unless Contractor is acting in such capacities). The cost to Contractor of performing any of its obligations under this Section 12.2.7 to the extent not covered by insurance shall be borne by Contractor.

§ 12.2.8 If, however, the Owner and Contractor deem it inexpedient to require the correction of Work damaged or not done in accordance with the Contract Documents, an equitable deduction from the Contract Sum shall be made by agreement between Contractor and Owner. Until such settlement, Owner may withhold such sums as Owner deems just and reasonable from moneys, if any, due Contractor. The settlement shall not be unreasonably delayed by the Owner and the amount of money withheld shall be based on estimated actual cost of the correction to Owner.

§ 12.2.9 Contractor's express warranty herein shall be in addition to, and not in lieu of, any other remedies Owner may have under the Contract Documents, at law or in equity, for defective Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the ~~law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern~~ Section 15.4-laws of the State of Texas, without regard to choice-of-law rules of any jurisdiction. The Contract is deemed performable entirely in the County in which the Project is located. Any litigation to enforce or interpret any terms of the Contract, or any other litigation arising out of or as a result of the Contract, shall be brought in the State courts of said County. No provision of this Agreement shall waive any immunity or defense.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in ~~Section 13.2.2~~, Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. Except for tests, inspections and approvals required to be provided by the Contractor in the Contract Documents, the Owner will contract for, independently of the Contractor, the inspection services, the testing of construction materials engineering, and the verification testing services necessary for the acceptance of the Work by the Owner. The Contractor shall give timely notice to the persons or entities selected by the Owner of the need for such services. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located, in accordance with the Texas Prompt Payment Act, Texas Gov't Code Chapter 2251. Any such payment shall be deemed overdue on the thirty-first (31st) day after Owner receives the Contractor's Certificate for Payment from the Architect, if Owner's Board of Trustees meets more than once per month. Any such payment shall be deemed overdue on the forty-sixth (46th) day after Owner receives the Contractor's Certificate for Payment from the Architect, if Owner's Board of Trustees meets once a month or less frequently. No interest shall be due on sums properly retained by Owner, except as provided by law, or on disputed sums unpaid by Owner.

§ 13.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.7 CONTRACTORS RECORDS

§ 13.7.1 Contractor agrees to furnish Owner such information as may be available in Contractor's files and records for the Project for the purpose of aiding Owner in establishing a depreciation schedule for the Project or such portions thereof as Owner may determine.

§ 13.7.2 Contractor shall at all times through the date of Final Completion, maintain Job Records, including, but not limited to, invoices, payment records, payroll record, daily reports, diaries, logs, instructions, drawings, receipts, contracts, purchase orders, vouchers, memoranda, other financial data and job meeting minutes applicable to the Project, in a manner which maintains the integrity of the documents. Job Records must be retained by Contractor for at least twelve (12) years after the date of Final Completion of the Project. Within ten (10) days of Owner's request, Contractor shall make such Job Records available for inspection, copying and auditing by the Owner, Architect or their respective representatives, at Owner's central office.

13.7.3 For all Change Orders, Allowances and expenditures from Contingency Funds, Contractor shall also maintain, in accordance with the provisions of Section 13.9.1, the following: contract files, including proposals of successful and unsuccessful bidders, bid recaps and contractor payments; original estimates; estimating Work sheets; general ledger entries detail cash and trade discounts received; insurance rebates and dividends; and any other supporting evidence deemed necessary by the Owner to substantiate charges related to the Contract.

13.7.4 Contractor shall keep a full and detailed financial accounting system and shall exercise such controls as may be necessary for proper financial management under this Contract; the accounting and control system shall be satisfactory to the Owner.

13.7.5 Contractor shall keep all Construction Documents related to the Project, provided, however, Contractor shall not destroy said documents until Contractor has confirmed with Owner in writing that Owner has obtained a copy of all as-built drawings.

13.7.6 In the event that an audit by the Owner reveals any errors/overpayments by the Owner, then the Contractor shall refund to the Owner the full amount of such overpayment within thirty (30) days of such audit findings, or the Owner, as its option, reserves the right to deduct such amounts owed to the Owner from any payments due to the Contractor.

§ 13.8 NO THIRD-PARTY BENEFICIARIES

There are no third-party beneficiaries to this agreement.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 ~~The Contractor may terminate the Contract if~~ If the Work is stopped for a period of ~~30~~ thirty (30) consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work, for any of the following reasons: the Work under direct or indirect contract with the Contractor, for any of the reasons set forth below, the Contractor may terminate the Contract upon twenty (20) days written notice to Owner and Architect if the Work is not allowed to commence within such period. The sole grounds for termination under this Subsection 14.1.1 are as follows:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped; or
- .3 Because ~~the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made the Owner has not made a~~ payment on a Certificate for Payment within the time stated in the Contract Documents; or Documents.

- ~~4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2. Intentionally deleted.~~

§ 14.1.2 ~~The Contractor may terminate the Contract if, If~~ through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is ~~less-less,~~ the Contractor may terminate the Contract so long as Contractor has provided Owner and Architect with written notice of its intent to terminate in the event of additional delays of not less than twenty (20) days and has furnished written notice of termination to Owner and Architect no less than seven (7) days prior to the effective date of termination.

§ 14.1.3 If one of the reasons described in ~~Section 14.1.1~~ Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment ~~for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination. in an amount which would have been recoverable had the termination been for the Owner's convenience.~~

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in ~~Section 14.1.3.~~ Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- ~~1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;~~
- ~~2 fails to make payment to Subcontractors or suppliers for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers; Subcontractors;~~
- ~~3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or~~
- ~~4 or any Subcontractor becomes insolvent, enters bankruptcy, receivership or other like proceeding; voluntary or involuntarily, or makes an assignment for the benefit of creditors; and the Contractor, within fifteen (15) days after receipt of notice from the Owner, fails to provide satisfactory evidence that the Contractor will either (i) perform the Work of such Subcontractor with the Contractor's own forces, in a timely manner, or (ii) replace the Subcontractor with another similarly qualified Subcontractor who is ready, willing and able to do such Subcontractor's Work in a timely manner~~
- ~~5 fails to proceed continuously and diligently with the construction and completion of the Work; except as permitted under the Contract Documents; or~~
- ~~6 otherwise is guilty of substantial breach of a provision of the Contract Documents.~~

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, ~~and upon certification by the Architect that sufficient cause exists to justify such action,~~ the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- ~~1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;~~
- ~~2 Accept assignment of subcontracts pursuant to Section 5.4; Section 5.4; and~~
- ~~3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.~~

In any such event, title to the Work and any products thereof, whether completed or partially completed, as well as all materials prepared, procured or set aside by the Contractor for use in the Work, shall vest in the Owner at the Owner's option, and the Owner may enter the Contractor's premises and remove the same therefrom. No election

hereunder shall be construed as a waiver of any rights or remedies of the Owner with regard to any breach of the contract Documents.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall may be adjusted for reasonable, actual, and verifiable increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include reasonable profit. No adjustment shall be made to the extent extent:

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause, cause by giving Contractor seven (7) days notice.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall shall:

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders, orders related to the Project.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement. executed, for profit only on that portion of the Work executed, and reasonable costs of demobilization.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

~~The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.~~

§ 15.1.2 Intentionally deleted.

§ 15.1.3 Notice of Claims

~~§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall the Contractor, must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claim. Claims must be initiated by written notice to the Architect and the Owner.~~

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments of any undisputed amounts in accordance with the Contract Documents. The Architect will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's Owner's decision, subject to the right of either party the Contractor to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 ~~If adverse~~ The Contractor shall be entitled to an extension of the Contract Time for delays or disruptions due to unusually inclement weather in excess of that normally experienced at the job site. Such extension of time will be granted only if such unusual inclement weather prevented the execution of Work on normal working days. Unusual inclement weather as used herein means unusually severe weather which is beyond the normal weather recorded and expected for the locality of the Work and/or the season or seasons of the year. Normal weather conditions shall be determined based upon information compiled from the records of the U.S. Weather Bureau Station at the location of the Work. If unusually inclement weather conditions are the basis for a Claim-claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, such conditions, the fact that the same could not have been reasonably anticipated, and the fact that they had an adverse effect on the scheduled construction. The Contractor shall bear the entire economic risk of all weather delays and disruptions, and shall not be entitled to any increase in the Contract Price by reason of such delays or disruptions. Requests for an extension of time pursuant to this Subparagraph shall be submitted to the Architect not later than the fifteenth day of the month following the month during which the delays or disruptions occurred.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.1.7 Calculating Claims for Damages

Except as otherwise provided in this Agreement, in calculating the amount of any Claim recoverable by the Contractor, the following standards will apply:

- .1 No indirect or consequential damages will be allowed.
- .2 No recovery shall be based on a comparison of planned expenditures to total actual expenditures, or on estimated loss of labor efficiency, or on a comparison of planned manloading to actual manloading, or any other analysis that is used to show damages indirectly.
- .3 Damages are limited to extra costs specifically shown to have been directly caused by a proven wrong.
- .4 No damages will be allowed for home office overhead or other home office changes or any Eichlay formula calculation.

§ 15.2 Initial Decision

~~§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision—~~
1 Claims by the Contractor against the Owner, including those alleging an error or omission by the Architect but excluding those arising under Section 10.3, shall be referred initially to the Architect for consideration and recommendation to the Owner. An initial recommendation by the Architect shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days Claim arising prior to the date final payment is due, unless thirty days have passed after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.
~~Architect with no recommendation having been rendered by the Architect.~~

~~§ 15.2.2 The Initial Decision Maker Architect will review Claims and within ten (10) days of the receipt of a the Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.~~
Contractor; (2) issue an initial recommendation; (3) suggest a compromise; or (4) advise the parties that the Architect is unable to issue an initial recommendation due to a lack of sufficient information or conflict of interest.

~~§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense. Following receipt of the Architect's initial recommendation regarding a claim, the Owner and Contractor shall attempt to reach agreement as to any adjustment to the Contract Price and/or~~

Contract Time. If no agreement can be reached either party may request mediation of the dispute pursuant to Article 15.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 ~~The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.~~Intentionally deleted.

§ 15.2.6 ~~Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.~~Intentionally deleted.

§ 15.2.6.1 ~~Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.~~Intentionally deleted.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 ~~If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.~~Waiver of Lien
It is distinctly understood that by virtue of this Contract, no mechanic, contractor, materialman, artisan, or laborer, whether skilled or unskilled, shall ever in any manner have, claim, or acquire any lien upon the building, or any of the improvements of whatever nature or kind so erected or to be erected by virtue of this Contract nor upon any of the land upon which said building or any of the improvements are so erected, built, or situated.

§ 15.3 Mediation

§ 15.3.1 ~~Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.~~In the event that the Owner or the Contractor shall contend that the other has committed a material breach of this Agreement, the party alleging such breach shall, as a condition precedent to filing any lawsuit, request mediation of the dispute.

§ 15.3.2 ~~The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.~~Request for mediation shall be in writing, and shall request that the mediation commence not less than thirty (30) or more than ninety (90) days following the date of the request, except upon agreement of both parties.

§ 15.3.3 ~~Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the~~

~~other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision. In the event the Owner and the Contractor are unable to agree to a date for the mediation or to the identity of the mediator or mediators within thirty days following the date of the request for mediation, all conditions precedent in this article shall be deemed to have occurred.~~

~~§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof. Nothing herein shall preclude the Owner or the Contractor from requesting that the Architect or one or more subcontractors be joined as parties to the mediation, to the extent allowed by their respective contracts.~~

~~15.3.5 Unless otherwise agreed in writing by the Owner in the Owner's sole discretion, the Contractor may not bring a legal action against the Owner unless:~~

- ~~.1 the Contractor has given written notice to the Owner of the Claim, dispute, or other matter giving rise to the legal action within ninety-one (91) days after the date of the start of the event giving rise to the Contractor's Claim, dispute or other matter, and~~
- ~~.2 the legal action is brought within two (2) years and one (1) day after the date of the start of the event giving rise to Contractor's Claim, dispute or other matter.~~

~~§ 15.4 Arbitration/Immunity~~

~~§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded. The parties do not agree to submit any Claim or dispute to binding arbitration. Any dispute or Claim not resolved by mediation as set forth in Section 15.3 shall be resolved by litigation in a court of competent jurisdiction.~~

~~§ 15.4.1.1 Intentionally deleted.~~

~~§ 15.4.2 Intentionally deleted.~~

~~§ 15.4.3 Intentionally deleted.~~

~~§ 15.4.4 Intentionally deleted.~~

ARTICLE 16 BUSINESS ETHICS

~~§ 16.1 During the course of pursuing contracts, and the course of Contract performance, Contractor and its Subcontractors and vendors will maintain business ethics standards aimed at avoiding real or apparent impropriety or conflicts of interest. No substantial gifts, entertainment, payments, loans or other considerations beyond that which would be collectively categorized as incidental shall be made to any personnel of the Owner, or to family members of any of them. At any time Contractor believes there may have been a violation of this obligation, Contractor shall notify Owner of the possible violation. Owner is entitled to request a representation letter from Contractor, its Subcontractors, or vendors at any time to disclose all things of value passing from Contractor, its Subcontractors, or vendors to Owner's personnel.~~

ARTICLE 17 ISRAEL/TERRORIST ORGANIZATION/ANTI-BOYCOTT/DISCRIMINATION

~~17.1 Pursuant to Texas Government Code Chapter 2271, the Contractor represents and warrants to the Owner that the Contractor does not boycott Israel and will not boycott Israel during the term of this Agreement.~~

~~17.2 Contractor verifies and affirms that it is not a foreign terrorist organization as identified on the list prepared and maintained by the Texas Comptroller of Public Accounts. If Contractor has misrepresented its inclusion on the~~

Comptroller's list such omission or misrepresentation will void this Agreement.

17.3 The Contractor represents and warrants to the Owner that the Contractor does not boycott energy companies as contemplated by Chapter 809 of the Government Code and will not boycott energy companies during the term of this Agreement.

17.4 The Contractor represents and warrants to the Owner that the Contractor does not discriminate against firearm and ammunition companies and trade associations as contemplated by Chapter 2274 of the Government Code and will not so discriminate during the term of this Agreement

ARTICLE 18 TEXAS GOVERNMENT CODE 552, SUBCHAPTER J

18.1 Pursuant to Texas Government Code 552, Subchapter J, the Contractor agrees to be bound by the following terms if the Contract has a stated expenditure of at least \$1,000,000 for the purchase of goods or services by the District or if the Contract results in the expenditure of at least \$1,000,000 in public funds for the purchase of goods or services by the District in a fiscal year of the District. If the District receives a written request for public information related to this Contract that is in the possession or custody of the Contractor and not in the possession or custody of the District, the District shall send, not later than the third business day after the date the District receives the written request, a written request to the Contractor that Contractor provide that information to the District.

18.2 The Contractor must:

- .1 Preserve all contracting information related to the Contract as provided by the records retention requirements applicable to the District for the duration of the Contract;
- .2 Promptly, within four business days, provide to the District any requested contracting information that is in the custody or possession of the Contractor upon request of the District; and,
- .3 On completion of the Contract, either:
 - .1 Provide to the District at no cost all contracting information related to the Contract that is in the custody or possession of the Contractor; or
 - .2 Preserve the contracting information related to the Contract as provided by the records retention requirements applicable to the District.
- .4 The requirements of Subchapter J, Chapter 552, Government Code may apply to this Contract, and the Contractor agrees that the contract can be terminated if the Contractor knowingly or intentionally fails to comply with the requirements of that subchapter.
- .5 Further, under Texas Government Code Chapter 552.372(c), the District may not accept a bid for or awarding of a contract to an entity that the District has determined has knowingly or intentionally failed in a previous bid or contract to comply with Subchapter J, unless the District determines and documents that the entity has taken adequate steps to ensure future compliance.
- .6 If a Contractor fails to provide to the District the requested information, Texas Government Code Chapter 552.373 requires the District to notify the Contractor in writing of the failure and allow 10 business days to cure the violation. District may terminate the Contract if Contractor fails to remedy the failure, District determines the failure was knowing and intentional, and steps have not been taken to ensure future compliance.

This Agreement is entered into as of the final day all parties have signed below.

OWNER:
HUFFMAN INDEPENDENT SCHOOL DISTRICT

CONTRACTOR:
TBD

By:

Signature

«Dr. Angeles Perez», «Superintendent »
(Printed name and title)

Date:

By:

Signature

« »
(Printed name and title)

Date:

~~§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.~~

~~§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).~~

~~§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.~~

~~§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.~~

~~§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.~~

~~§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.~~

ATTACHMENT D
PROJECT INFORMATION - SCOPE OF SERVICES

1. Description Of the Project.

- 1.1 NAME.** The name of the Project is: HUFFMAN ISD NEW CTE CENTER & HARGRAVE HIGH SCHOOL ADDITIONS & RENOVATIONS IMPROVEMENTS
- 1.2 LOCATION.** Hargrave High School, 25400 Willy Ln, Huffman, TX, 77336
- 1.3 ARCHITECT.** The District has selected the following firm as the Architect for the Project: PBK Architects, 11 Greenway Plaza Suite 22, Houston, TX 77046.
- 1.4 SCOPE.** The Work of Project is defined by the Contract Documents and consists of the following:
- (1) Career and Technical Education Center
A new 46,000 square foot single story steel structure building including an administrative suite, culinary kitchen, vet tech lab, health science lab, flexible classrooms, flexible shop / lab spaces to support engineering, agricultural sciences, carpentry, business, law, and audio-visual career pathways, facility support spaces, and a central plant. Other amenities include an aluminum walkway canopy to connect to the existing Ag Mech building, concrete parking lot, and a landscaped entrance.
 - (2) Renovation and Addition to existing Ag Mech
Renovation and reconfiguration of existing classroom and lab spaces to create an additional welding lab and a adult restroom. Existing student restrooms will not be modified. Exterior improvements include a 9,000 square foot roof addition onto the existing open air pavilion.
 - (3) Hargrave High School Renovation and Addition
A new 18,000 square foot gymnasium and athletics addition with 1,200 spectator seats, a training suite with office, locker room addition, mezzanine expansion, minor renovations to portions of the existing locker room spaces as required for incorporation of new addition, and roofing renovations. Exterior improvements include new security fencing, modification of existing sidewalks and drives adjacent to the gymnasium addition as required for incorporation of new addition.
- 1.5 TIME OF COMMENCEMENT AND COMPLETION.** Actual construction on the Project projected to begin in August 2025. There are multiple completion dates within the project, see project for details. Overall substantial project completion is Summer 2027.
- 1.6 ESTIMATED PROJECT BUDGET.** \$ 4 3 , 2 6 6 , 0 1 7
- 1.7 LIQUIDATED DAMAGES.** This Project shall include a liquidated damages provision providing for liquidated damages for each calendar day of delay until the Work is substantially complete. The provisions will be set forth in the form of document provided at Attachment C. For this Project, the liquidated damages shall be stipulated as \$500.00 per day.
- 1.8 UMBRELLA OR EXCESS INSURANCE.** This project shall have umbrella or excess liability insurance in the amount of \$5,000,000.
- 1.9 PRE-PROPOSAL CONFERENCE:** A Pre-Proposal Conference will be conducted on May 28, 2025, at 9:00 AM at the Administration Building, located at 24302 FM 2100 Huffman, Texas 77336. After the presentation in the conference room there will immediately be an on-site meeting to view existing conditions of the work area, subcontractors are encouraged to attend pre-proposal and/or site tour. The District's responses to questions received at or before the Pre-Proposal Conference may be distributed

at the Pre-Proposal Conference, and later questions will be distributed online via addendum at <https://huffmanisd.ionwave.net> to Proposers who have picked up the RFCSP documents thereafter. Attendance at the Pre-Submittal Conference is **not mandatory, but attendance is strongly encouraged**. The location for the Pre-Submittal Conference is accessible to disabled persons. To arrange for special assistance to access this meeting, or if you have questions regarding accessibility, please contact the District in advance of the meeting. An additional site walk opportunity for subcontractors will take place on at 9:00 AM on June 4, 2025 at Hargrave High School main entrance.

1.10 CONTRACT DOCUMENTS. Contract Documents may be obtained from the HISD Purchasing Office online website at <https://huffmanisd.ionwave.net>

1.11 SCHEDULE.

Issue RFCSP	May 23, 2025
Pre-Proposal Meeting	May 28, 2025 at 9:00 AM
Subcontractor Site Walk	June 4, 2025 at 9:00 AM
Last Date for Inquiries	June 9, 2025 at 4:00 PM
Last Addendum Issued (if required)	June 16, 2025
Proposal Questionnaire Due via Email	June 17, 2025 at 2:00 PM
Receive Proposal Attachments and Forms from Ion Wave	June 19, 2025 at 2:00 PM
Public Opening and Reading Proposal Results	June 19, 2025 at 2:00 PM
Subcontractor Questionnaire Due via Email	June 20, 2025 at 2:00 PM
Present to the School Board	July 28, 2025 at 7:00PM
Notice to Proceed	July 29, 2025
Substantial Completion	February 28, 2027

ATTACHMENT E
PRICING PROPOSAL

This Proposal is submitted by _____, whose address is _____, (hereafter called "Proposer"), for the construction of "**Huffman ISD New CTE Center & Hargrave High School Additions & Renovations**" (hereafter called "Project").

Monetary Proposal: Proposer agrees to furnish for the total sum, including a \$2,000,000 contingency, of _____ Dollars (\$_____) all labor, services, materials, tools, equipment and supervision necessary to the full and final completions of the Project, as defined by the RFCSP, and everything incidental thereto, or properly inferable therefrom, all in accordance with the Project Specifications included in this RFCSP No. 04-2025 issues by the District.

Alternate Proposals:

Alternate No 1: 23 09 23 – Direct Digital Controls – **Unify Energy Solutions**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 2a: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **Daikin**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 2b: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **Carrier**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 2c: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **Trane**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 2d: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **JCI**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 3a: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **Daikin**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 3b: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **Trane**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 3c: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **Carrier**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 3d: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **JCI**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 4: 23 81 26 – Ductless Mini-Split-System Air-Conditioners – **Daikin**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 5a: 23 82 19.13 – Fan Coil Units – **Daikin**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 5b: 23 82 19.13 – Fan Coil Units – **Carrier**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 5c: 23 82 19.13 – Fan Coil Units – **Trane**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Alternate No 5d: 23 82 19.13 – Fan Coil Units – **JCI**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

Contractor offers and proposes to perform the Work, in accordance with the Contract Documents, for the Contract Amount based on the Pricing Schedule set forth below, within the Substantial Completion Dates required by the Owner.

Acknowledgment of Addenda. Proposer acknowledges receipt of Addenda Nos. _____ through _____ and that the Proposals contained herein are offered after review and consideration of same.

_____ No Addenda were issued (initial)

Proposer agrees that if any revisions are requested to the terms and conditions in the Agreements attached as Attachment C, such proposed revisions and the Proposer's explanation for each revision is attached on a separate sheet and submitted with the Proposal response.

By its signature below, Proposer represents that, in preparing this Proposal, Proposer has carefully read the Contract Documents, examined the site of the Project, including the Component Projects, if any, and had made an investigation such that he or she is fully informed of the conditions, facilities, difficulties, restrictions and requirements which Proposer will, or may encounter in the completion of the Project(s) in accordance with the terms of the Contract Documents.

Executed on _____, 2025.

Proposer: _____
[Provide full name and business structure of Proposer]

Signature

Printed Name, Title

Note: If Proposer is a Joint Venture, an authorized signature from a representative of each party is required

ATTACHMENT F
UNIT PRICE PROPOSAL

**HUFFMAN ISD NEW CTE CENTER & HARGRAVE HIGH SCHOOL ADDITIONS &
RENOVATIONS IMPROVEMENTS**

Having examined Proposal and Contract Documents prepared by PBK, Inc., and having examined site conditions, the undersigned proposes to furnish all labor, equipment and materials, as required in the specifications, and perform all work for the completion of the above-named project for the sum indicated below.

UNIT PRICE

1. Unit Price 1: Removal of unsatisfactory soil and replacement with satisfactory soil material:
PER CUBIC YARD

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

2. Unit Price No. 2: Rock excavation and replacement with satisfactory soil material:
PER CUBIC YARD

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

3. Unit Price No. 3: Cutting and patching of concrete floor slabs: **PER SQUARE FOOT**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

4. Unit Price No. 4: Concrete: **PER CUBIC YARD**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

5. Unit Price No. 5: Select Fill: **PER CUBIC YARD**

ADD _____ Dollars \$ _____
(Amount written in words governs) (Amount in figures)

6. Unit Price No. 6: Grade Beam (Add): **PER LINEAR FOOT**

CTE Building

GB1	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
GB2	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
GB3	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
GB4	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)

GB5	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB6	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)

GYM Building

GB1	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB2	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB3	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB4	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB5	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB6	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB7	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB8	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB9	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)

AG Building

GB1	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB2	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)

7. Unit Price No. 7: Grade Beam (Deduct): **PER LINEAR FOOT**

CTE Building

GB1	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB2	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB3	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB4	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB5	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB6	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)

GYM Building

GB1	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB2	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB3	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB4	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB5	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB6	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB7	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB8	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB9	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)

AG Building

GB1	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)
GB2	DEDUCT	_____	\$
		(Amount written in words governs)	(Amount in figures)

8. Unit Price No. 8: Drilled Pier (Add): PER EACH

18/48	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
24/60	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
30/72	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
30/78	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
30/84	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
36/90	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
36/96	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
42/102	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)
42/108	ADD	_____	\$
		(Amount written in words governs)	(Amount in figures)

42/114	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
48/120	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
48/126	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)

9. Unit Price No. 9: Drilled Pier (Deduct): **PER EACH**

18/48	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
24/60	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
30/72	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
30/78	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
30/84	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
36/90	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
36/96	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
42/102	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
42/108	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
42/114	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
48/120	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
48/126	DEDUCT _____	\$ _____
	(Amount written in words governs)	(Amount in figures)

10. Unit Price No. 10: Pier Casings: **PER EACH**

Where Caving / Sloughing Occurs in the Shaft

18/48	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
24/60	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
30/72	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)
30/78	ADD _____	\$ _____
	(Amount written in words governs)	(Amount in figures)

30/84	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
36/90	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
36/96	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
42/102	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
42/108	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
42/114	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
48/120	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
48/126	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)

Where Caving Occurs in the Bell

18/48	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
24/60	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
30/72	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
30/78	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
30/84	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
36/90	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
36/96	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
42/102	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
42/108	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
42/114	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
48/120	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)
48/126	ADD _____ (Amount written in words governs)	\$ _____ (Amount in figures)

11. Unit Price No. 11: Miscellaneous and structural steel: **PER POUND**

ADD _____ \$ _____
(Amount written in words governs) (Amount in figures)

12. Unit Price No. 12: Existing Pier Demo Condition 2 (No Conflict with New Piers): **PER EACH**

ADD _____ \$ _____
(Amount written in words governs) (Amount in figures)

It is understood that the right is reserved by the Owner to reject any or all proposals, or waive any informalities in the proposal process.

(Seal, if a Corporation)
State whether Corporation,
Partnership or Individual

Authorized Signature

Title

Name of Contracting Firm

Date

ATTACHMENT G
CONTRACTOR CRIMINAL BACKGROUND SB9 CERTIFICATION

Introduction: Texas Education Code Chapter 22 requires service contractors to obtain criminal history records on covered employees. Covered employees with disqualifying convictions are prohibited from serving at a school district. Contractors must certify to the district that they have complied and must obtain similar certifications from their subcontractors. For more information or to set up an account, a contractor should contact the Texas Department of Public Safety's Crime Records Service at 512-424-2474. The district has no input to, or control of the DPS process.

Definitions: *Covered Employee:* Employees of a contractor who have or will have *continuing duties* related to the service to be performed at the District and have or will have *direct contact* with students. The District will be the final arbiter of what constitutes continuing duties or direct contact with students.

Disqualifying criminal history: (1) a conviction or other criminal history information designated by the District; or (2) one of the following offenses, if at the time of the offense, the victim was under 18 or enrolled in a public school: (a) a felony offense under Title 5, Texas Penalty Code; (b) an offense for which the defendant is required to register as a sex offender under Chapter 62, Texas Code of Criminal Procedure; (c) an equivalent offense under federal law or the laws of another state.

On behalf of _____ ("Contractor"), I, the undersigned authorized signatory for Contractor, certify to Huffman ISD ("District") that [Check one]:

☐ None of Contractor's employees are *covered employees*, as defined above. I further certify that Contractor has taken precautions or imposed conditions to ensure that its employees will not become *covered employees*. Contractor will maintain these precautions or conditions throughout the time the contracted services are provided.

Or

☐ Some or all of Contractor's employees are *covered employees*. *If this box is selected*, I further certify that:

- (1) To the extent permitted by law, Contractor has obtained all required criminal history record information, through the Texas Department of Public Safety, regarding its covered employees. None of the covered employees has a disqualifying criminal history.
- (2) If Contractor receives information that a covered employee subsequently has a reported criminal history, Contractor will immediately remove the covered employee from contract duties and notify the District in writing within three (3) business days.
- (3) Upon request, Contractor will provide the District with the name and any other requested information of covered employees so that the District may obtain criminal history record information on the covered employees.

If the District objects to the assignment of a covered employee on the basis of the covered employee's criminal history record information, Contractor agrees to discontinue using that covered employee to provide services at the District.

I also certify to the District on behalf of Contractor that Contractor has obtained certifications from its subcontractors of compliance with Education Code, Chapter 22.

NONCOMPLIANCE OR MISREPRESENTATION REGARDING THIS CERTIFICATION MAY BE GROUNDS FOR CONTRACT TERMINATION.

Submitter's Signature: _____ Date: _____

Submitter's Name & Title: _____

Company Name: _____

Telephone # _____ (800) _____ Fax No. _____

Email Address: _____

Mailing Address: _____

City, State, & Zip: _____

This form is required to be completed and signed; however, only the successful Proposers will be required to comply with requirements set forth in Act of May 28, 2007, 80th Leg., R.S., S.B. 9, § 30. All related costs including background checks/fingerprinting shall be at the contractor's expense.

This sheet must be completed, signed, and returned with Prime Contractor's submittal.

ATTACHMENT H
TERMS AND CONDITIONS CERTIFICATION

Issuance of this RFCSP does not commit the District to award a contract or pay any costs incurred in the preparation of a response to this request.

The District reserves the right to waive any formality and to reject any or all proposals.

By submitting a response to this RFCSP, each proposer agrees to waive any and all claims it has or may have against the school district and its trustees, employees and officers, including, but not limited to, those arising out of or in connection with the administration, evaluation, or recommendation of any response or proposal; waiver of any requirements under this RFCSP, or the Contract Documents; acceptance or rejection of any response or proposal; and award of a contract.

Vendor verifies and affirms that it is not a foreign terrorist organization as identified on the list prepared and maintained by the Texas Comptroller of Public Accounts. If Vendor has misrepresented its inclusion on the Comptroller's list such omission or misrepresentation will void this Agreement.

Vendor represents and warrants to District that Vendor does not boycott energy companies as contemplated by Chapter 809 of the Government Code and will not boycott energy companies during the term of this Agreement.

Vendor represents and warrants to District that Vendor does not discriminate against firearm and ammunition companies and trade associations as contemplated by Chapter 2274 of the Government Code and will not so discriminate during the term of this Agreement.

By submitting a proposal, each proposer warrants that it has reviewed the enclosed Owner-modified AIA Documents A101, A101 - exhibit A, and A201 contract forms attached as Attachment C and agrees that it finds the terms acceptable and will execute a completed version of said forms as the contract for the projects, subject to the District's final approval.

By submitting a proposal, it is agreed that such proposal shall be valid and not withdrawn for a period of thirty (30) days from the date of opening.

By my signature below, I warrant that I am authorized to sign on behalf of my organization, and that I have read, understand, and agree with all the terms of this Request for Proposals.

By my signature, pursuant to Texas Government Code Chapter 2271, my organization represents and warrants to Huffman ISD that my organization does not boycott Israel and will not boycott Israel during the term of any agreement with Huffman ISD.

Name of Proposer

Date

Signature

This sheet must be completed, signed, and returned with Prime Contractor's submittal.

DOCUMENT 00 40 14 - AFFIDAVIT OF NON-ASBESTOS, LEAD, AND PCB USE IN PROJECT

Upon completion of this form, return to the Architect upon close-out of the project.

PROJECT:
New CTE Center & Hargrave High School
Additions & Renovations

ARCHITECT:
PBK
11 Greenway Plaza, 22nd Floor
Houston, Texas 77046

ARCHITECT'S PROJECT NO. 240157

CONTRACTOR: _____

DATE: _____

(Name, address) _____

AFFIDAVIT

The undersigned affirms and certifies that "to the best of their knowledge and belief asbestos, lead, and PCB containing materials have not been used or incorporated into the Work and lead or lead bearing materials have not been incorporated into potable water systems", including, but not limited to those water systems for drinking fountains, all sinks, showers, bath tubs, residential and commercial kitchen equipment, ice machines, and hose bibbs, as applicable to the project, and that lead sheet flashing used in through roof plumbing penetration applications is the only lead on the Project.

Company

Printed Name

Signature

STATE OF TEXAS)
)
COUNTY OF _____)

Sworn to and subscribed before me at _____, Texas, this the _____ day of _____, 20__.

Notary Public in and for _____ County, Texas

END OF DOCUMENT 00 40 14

NOTE: THIS DOCUMENT MUST BE EXECUTED AND SUBMITTED AT PROJECT CLOSE-OUT

DOCUMENT 00 50 00 - TEXAS STATUTORY PERFORMANCE BOND
(Penalty of this bond must be 100% of contract amount)

Bond No.: _____

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal, and _____
a corporation organized and existing under the laws of the State of _____
authorized and admitted to do business in the State of Texas and licensed by the State of Texas to
execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

(hereinafter called the Obligee) in the amount of _____

Dollars(\$ _____) for the payment whereof, the said Principal and Surety bind
themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally,
firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____
day of _____, 20__, for

**NEW CTE CENTER & HARGRAVE HIGH SCHOOL ADDITIONS & RENOVATIONS
HUFFMAN INDEPENDENT SCHOOL DISTRICT**

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at
length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal
shall faithfully perform the work in accordance with the plans, specifications and contract documents, then
this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the
Texas Government Code and all liabilities on this bond shall be determined in accordance with the
provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this
_____ day of _____, 20__.

(Seal)

Principal

Surety Address

By: _____

(Seal)

Surety Telephone Number

Surety

By: _____

Attorney-in-Fact

END OF DOCUMENT 00 50 00

DOCUMENT 00 50 01 - TEXAS STATUTORY PAYMENT BOND **Bond No.:** _____
(Penalty of this bond must be 100% of contract amount)

KNOW ALL MEN BY THESE PRESENTS, that: _____
(hereinafter called the Principal), as principal,
and _____
a corporation organized and existing under the laws of the State of _____
authorized and admitted to do business in the State of Texas and licensed by the State of Texas to
execute bonds as Surety (hereinafter called the Surety), as Surety, are held and firmly bound unto

(hereinafter called the Obligee) in the amount of _____

Dollars(\$_____) for the payment whereof, the said Principal and Surety bind
themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally,
firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____
day of _____, 20____, for

**NEW CTE CENTER & HARGRAVE HIGH SCHOOL ADDITIONS & RENOVATIONS
HUFFMAN INDEPENDENT SCHOOL DISTRICT**

which contract is hereby referred to and made a part hereof as fully and the same extent as if copied at
length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal
shall pay all claimants supplying labor and material to him or a Subcontractor in the prosecution of the
work provided for in said contract, then this obligation shall be void; otherwise to remain in full force and
effect.

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Chapter 2253 of the
Texas Government Code and all liabilities on this bond to all such claimants shall be determined in
accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this Instrument this
_____ day of _____, 20____.

Principal (Seal)

Witness: _____ By: _____

Witness: _____
Surety (Seal)

By: _____
Attorney-in-Fact

Surety Address

Surety Telephone Number

END OF DOCUMENT 00 50 01

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Phased construction.
 - 4. Work by Owner.
 - 5. Work under separate contracts.
 - 6. Purchase contracts.
 - 7. Owner furnished products.
 - 8. Owner furnished, Contractor installed products.
 - 9. Access to site.
 - 10. Coordination with occupants.
 - 11. Work restrictions.
 - 12. Specification and drawing conventions.
 - 13. Miscellaneous provisions.

1.3 PROJECT INFORMATION

- A. Project Identification: New CTE Center & Hargrave High School Additions & Renovations
 - 1. Project Locations:
 - a. Hargrave High School: 25400 Willy Lane, Huffman, Texas 77336
- B. Owner: Huffman Independent School District
 - 1. Owner's Representative: Brad Boullion, DRS
- C. Architect: PBK Architects, Houston, Texas.
- D. Engineer: LEAF Engineers, Houston, Texas
- E. Consultants: Additional design professionals have been retained who have prepared designated portions of the Contract Documents.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Career and Technical Education Center
 - a. A new 46,000 square foot single story steel structure building including an administrative suite, culinary kitchen, vet tech lab, health science lab, flexible classrooms, flexible shop / lab spaces to support engineering, agricultural sciences, carpentry, business, law, and audio-visual career pathways, facility support spaces, and a central plant. Other amenities include an aluminum walkway canopy to connect to the existing Ag Mech building, concrete parking lot, and a landscaped entrance.
 - 2. Renovation and Addition to existing Ag Mech
 - a. Renovation and reconfiguration of existing classroom and lab spaces to create an additional welding lab, and adult restroom. Existing student restrooms will not be

modified. Exterior improvements include a 9,000 square foot roof addition onto the existing open air pavilion.

3. Hargrave High School Renovation and Addition
 - a. A new 18,000 square foot gymnasium and athletics addition with 1,200 spectator seats, a training suite with office, locker room addition, mezzanine expansion, minor renovations to portions of the existing locker room spaces as required for incorporation of new addition, and roofing renovations. Exterior improvements include new security fencing, modification of existing sidewalks and drives adjacent to the gymnasium addition as required for incorporation of new addition.

- B. Type of Contract: Project will be constructed under a competitive sealed proposal (CSP) contract.

1.5 WORK BY OWNER AND UNDER SEPARATE CONTRACTS

- A. Cooperate fully with Owner so Work may be carried out smoothly, without interfering with or delaying the work or work by Owner. Coordinate the Work with Work performed by Owner.
- B. The Owner reserves the right to let separate contract for Work outside of the scope of this Contract. Cooperate fully with separate contractors so Work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with Work performed under separate contracts.
- C. Purchase Contracts: The Owner reserves the right to negotiate purchase contracts with suppliers of material and equipment that may be incorporated into the Work. The Owner will assign these purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum, unless otherwise indicated.
 1. Contractor's responsibilities are same as if Contractor had negotiated purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.
- D. Owner Furnished, Contractor Installed Products (OFCl): The Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner furnished products and making building services connections when applicable.
 1. Owner Furnished Products: Coordinate with Owner.

1.6 ACCESS TO SITE

- A. Use of Site: Limit use of Project site to Work in areas and areas within the Contract limits indicated. Do not disturb portions of site beyond areas in which the Work is indicated.
 1. Limits: The drawings indicate the limits of the construction operations.
 2. Driveways, Walkways, and Entrances: Keep driveways, parking areas, student drop off and pick up points, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, the students, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. **Perform Work to prevent interference with Owner's day to day operations.** Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

- A. Work Restrictions: Comply with restrictions on construction operations. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On Site Work Hours: Limit Work in the existing building to Monday through Friday, unless otherwise indicated. Coordinate with Owner when it is necessary to extend working hours or Work on weekends.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two weeks in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two weeks in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Controlled Substances, Firearms, and Explosive Devices: Use of tobacco products, controlled substances, firearms, and explosive devices on the site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on site. Require personnel to use identification tags at all times.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 1 General Requirements: Requirements of Sections in Division 1 apply to the Work of each specification section.

- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations.

1.10 COORDINATION WITH PROGRAM MANAGER

- A. HISD Standard:
1. The District has engaged in services of a Program Manager.
 2. The Program Manager shall act as the Owner's Representative and all communication with the District shall flow through the Program Management team.
 3. In some instances, there may be need to communicate directly with the District for efficiency or technical clarity. In this case you will be directed to do so.
 4. You may be contacted directly by a HISD employee. Should this happen a protocol for how and what is required of you post conversation will be established
 5. With very few exceptions you should never proceed based on what you were told until the Program Manager is made aware.
 6. No one at the District has authority to authorize a change in work, design, aesthetic selection, material change, physical change, or any other conceptual change except for the Superintendent of Schools.
 7. Any meeting between the A/E and the General Contractor where cost, schedule, process or alternative solutions are discussed, the entity facilitating the meeting shall invite the Program Manager. At the Program Manager's option, a written meeting report shall suffice.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 CONSTRUCTION SCHEDULE

- A. The Owner has a critical need for the Work to begin upon Notice to Proceed and shall be Substantially Complete by **February 28, 2027**. There will be No Extensions of Time due to weather.

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include:
 - 1. Lump sum allowances.
 - 2. Unit cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.

1.3 COORDINATION

- A. Coordinate allowance items with other portions of the Work.

1.4 LUMP SUM, UNIT COST, AND QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.5 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.

- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.6 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
 - 4. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher or lower priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related Work.

3.3 SCHEDULE OF ALLOWANCES

- A. Owner's Contingency Allowances: \$2,000,000.00
1. Contractor shall include the amount indicated below in his Base Proposal as a contingency to cover the cost of hidden, concealed or otherwise unforeseen conditions which develop during completion of the work. Contractor shall be allowed to recover all costs associated with the completion of work under this contingency, however, no overhead or profit will be allowed.

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for unit prices.

1.3 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to the individual Specification Sections for Work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this Work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
 - 1. Description: Unsatisfactory soil excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to Section 312000 "Earth Moving."
 - 2. Unit of Measurement: Cubic yard of soil excavated, based on survey of volume removed.
 - 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."
- B. Unit Price No. 2: Rock excavation and replacement with satisfactory soil material.
 - 1. Description: Classified rock excavation and disposal off site and replacement with satisfactory fill material or engineered fill from off site, as required, according to Section 312000 "Earth Moving."

2. Unit of Measurement: Cubic yard of rock excavated, based on survey of volume removed.
 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."
- C. Unit Price No. 3: Cutting and patching of concrete floor slabs.
1. Description: Cutting of new or existing concrete floor slabs up to 6 inches thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete according to Section 017300 "Execution." not otherwise indicated in the Contract Documents.
 2. Unit of Measurement: Square feet of concrete removed.
- D. Unit Price No. 4: Concrete
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new cement stabilized sand and lean concrete material delivered, spread, and compacted per plans and specs. Cost shall include all materials and labor for complete installation. Enter unit cost on Proposal form.
- E. Unit Price No. 5: Select Fill
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for one (1) cubic yard of new select fill material, delivered, spread, and compacted per plans and specs. Cost shall include all materials and labor for complete installation. Enter unit cost on Proposal Form.
- F. Unit Price No. 6: Grade Beam (Add)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials and labor for complete installation. Enter unit cost for each grade beam size on Proposal Form.
- G. Unit Price No. 7: Grade Beam (Deduct)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) linear foot of grade beam of each grade beam size utilized in the project per the grade beam schedule on S-302. Cost shall include all materials and labor for complete installation. Enter unit cost for each grade beam size on Proposal Form.
- H. Unit Price No. 8: Drilled Pier (Add)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the addition of one (1) drilled pier of each drilled pier size utilized in the project per 1/S-303. Cost shall include all materials and labor for complete installation. Enter unit cost for each drilled pier size on Proposal Form.
- I. Unit Price No. 9: Drilled Pier (Deduct)
1. Description: This Unit Price shall be the entire unit cost including overhead and profit for the removal of one (1) drilled pier of each drilled pier size utilized in the project per 1/S-303. Cost shall include all materials and labor for complete installation. Enter unit cost for each drilled pier size on Proposal Form.
- J. Unit Price No. 10: Pier Casings:
1. Description: The contractor shall provide a unit price for each size of casing for all pier types utilized on the project.
 2. Unit of Measurement: Net length of casing utilized multiplied by the unit price.
- K. Unit Price No. 11: Miscellaneous and structural steel.

1. Description: Miscellaneous lintels and other supports not otherwise indicated in the Contract Documents, according to Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications."
 2. Unit of Measurement: Cost in place of pounds of fabricated steel as indicated on itemized invoice of steel supplier and verified by Architect.
- L. Unit Price No. 12: Elevator jack hole rock.
1. Description: Subsurface soil conditions that refuse conventional auger excavation of the elevator jack hole, according to Section 142400 "Hydraulic Elevators."
 2. Unit of Measurement: Depth in feet of drilling required as indicated on the elevator Installer's invoice and verified by Architect.
 3. Assigned Unit Cost: Owner will pay \$250.00 per unit foot of rock drilling required.
- M. Unit Price No. 13: Existing Pier Demo Condition 1 (Overlap With New Pier):
1. Description: At any location where a new pier will overlap an existing footing/pier, the soil currently in the existing footing/pier shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including overhead for all of the work described in the GC Note on SD-101 – DEMO PLAN for each pier size.
- N. Unit Price No. 14: Existing Pier Demo Condition 2 (No Conflict with New Piers):
1. Description: At any location where an existing footing/pier does not overlap with a new pier, the portion of the existing footing/pier within 4.5-ft of the bottom of the future slab shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698). The testing and inspections laboratory shall be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved. This unit price shall cover the entire unit cost including overhead for all of the work described in the GC Note on SD-101 – DEMO PLAN for each pier size.

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes: Administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain Work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described are part of the Work when enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent Work as necessary to completely integrate Work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Forty-eight (48) hours following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other Work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate Number 1: 23 09 23 – Direct Digital Controls – **Unify Energy Solutions**
 - 1. This Alternate shall establish the amount to adjust the Base Proposal for the cost of furnishing and installing Direct Digital Controls manufactured by Reliable Controls– Installed by **Unify Energy Solutions – Houston**. This alternate shall include the pricing for all materials and labor for proper completion. Refer to specs and drawings for additional information.

- B. Alternate Number 2a: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **Daikin**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Scroll Water Chillers Air-Cooled and Rotary-Screw Water Chillers Air-Cooled (High School), manufactured by **Daikin** as shown and scheduled on the drawings and as specified. Alternate chiller price shall include (5) five-year parts, labor, refrigerant, etc. extended warranty (re: 1.11 Warranty) as well as (5) five year Preventative Maintenance Service (re: 1.12 Preventative Maintenance Service); there are no chillers included in the base bid.
- C. Alternate Number 2b: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **Carrier**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Scroll Water Chillers Air-Cooled and Rotary-Screw Water Chillers Air-Cooled (High School), manufactured by **Carrier** as shown and scheduled on the drawings and as specified. Alternate chiller price shall include (5) five-year parts, labor, refrigerant, etc. extended warranty (re: 1.11 Warranty) as well as (5) five year Preventative Maintenance Service (re: 1.12 Preventative Maintenance Service); there are no chillers included in the base bid.
- D. Alternate Number 2c: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **Trane**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Scroll Water Chillers Air-Cooled and Rotary-Screw Water Chillers Air-Cooled (High School), manufactured by **Trane** as shown and scheduled on the drawings and as specified. Alternate chiller price shall include (5) five-year parts, labor, refrigerant, etc. extended warranty (re: 1.11 Warranty) as well as (5) five year Preventative Maintenance Service (re: 1.12 Preventative Maintenance Service); there are no chillers included in the base bid.
- E. Alternate Number 2d: 23 64 23 – Scroll Water Chillers Air-Cooled (CTE Building) & 23 64 27 – Rotary-Screw Water Chillers Air-Cooled (High School) – **JCI**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Scroll Water Chillers Air-Cooled and Rotary-Screw Water Chillers Air-Cooled (High School), manufactured by **JCI** as shown and scheduled on the drawings and as specified. Alternate chiller price shall include (5) five-year parts, labor, refrigerant, etc. extended warranty (re: 1.11 Warranty) as well as (5) five year Preventative Maintenance Service (re: 1.12 Preventative Maintenance Service); there are no chillers included in the base bid.
- F. Alternate Number 3a: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **Daikin**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Modular Indoor Central-Station Air- Handling Units, manufactured by **Daikin** as shown and scheduled on the drawings and as specified; there are no Modular Indoor Central -Station Air-Handling Units included in the base bid.
- G. Alternate Number 3b: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **Trane**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Modular Indoor Central-Station Air- Handling Units, manufactured by **Trane** as shown and scheduled on the drawings and as specified; there are no Modular Indoor Central -Station Air-Handling Units included in the base bid.

- H. Alternate Number 3c: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **Carrier**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Modular Indoor Central-Station Air- Handling Units, manufactured by **Carrier** as shown and scheduled on the drawings and as specified; there are no Modular Indoor Central -Station Air-Handling Units included in the base bid.
- I. Alternate Number 3d: 23 73 13 – Modular Indoor Central-Station Air-Handling Units – **JCI**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Modular Indoor Central-Station Air- Handling Units, manufactured by **JCI** as shown and scheduled on the drawings and as specified; there are no Modular Indoor Central -Station Air-Handling Units included in the base bid.
- J. Alternate Number 4: 23 81 26 – Ductless Mini-Split-System Air-Conditioners– **Daikin**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Ductless Mini Split System Air Conditioners, manufactured by **Daikin** as shown and scheduled on the drawings and as specified; there are no Ductless Mini Split System Air Conditioners included in the base bid.
- K. Alternate Number 5a: 23 82 19.13 – Fan Coil Units – **Daikin**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **Daikin** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.
- L. Alternate Number 5b: 23 82 19.13 – Fan Coil Units – **Carrier**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **Carrier** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.
- M. Alternate Number 5c: 23 82 19.13 – Fan Coil Units – **Trane**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **Trane** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.
- N. Alternate Number 5d: 23 82 19.13 – Fan Coil Units – **JCI**
1. This Alternate shall establish the amount to be added to the Base Proposal for the Contractor to furnish Fan Coil Units, manufactured by **JCI** as shown and scheduled on the drawings and as specified; there are no Fan Coil Units included in the base bid.

END OF SECTION 01 23 00

SECTION 01 25 13 - PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Specified product compliance, and product quality assurance.
- B. Specific administrative and procedural requirements for handling requests for substitutions made prior to award of Contract.
- C. Requirements for product delivery, storage and handling.

1.3 RELATED REQUIREMENTS

- A. Instructions to Offerors: Product options and procedures for submittal of requests for substitutions during the Proposal period.

1.4 DESCRIPTION OF REQUIREMENTS

- A. Definitions: Definitions used in this Section are not intended to negate the meaning of other terms used in the Contract Documents, including such terms as "specialties", "systems", "structure", "finishes", "accessories", "furnishings", "special construction", and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.
 - 1. Products: Shall mean items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor's previously purchased stock. The term "product" as used herein includes the terms "material", "equipment", "system", and other terms of similar intent.
 - a. Named Products: Are those identified by the use of the manufacturer's name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the Contract Documents.
 - b. Specified Products: same as Named Products.
 - 2. Materials: Shall mean products that must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form units of work.
 - 3. Equipment: Is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

1.5 PRODUCT QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.
 - 1. When it is discovered that specific products are available only from sources that do not or cannot produce an adequate quantity to complete project requirements in a timely manner, consult with the Architect/Engineer for a determination of what product quantities are most important before proceeding. The Architect/Engineer will designate those qualities, such as visual, structural, durability, or compatibility, that are most important. When the Architect/Engineer's determination has been made, select products from those sources that produce products that possess the most important qualities, to the fullest extent possible.

- B. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two (2) or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract Documents, but must be provided by the Contractor.
- C. Or Equal:
 - 1. Where the phrase "or equal", "or equivalent", "or Architects approved equal", or similar phrasing, occurs in the Proposal Documents, do not assume that materials, equipment, or methods of construction will be approved by the Architect unless the item has been specifically approved for this Work by the Architect.
 - 2. The decision of the Architect shall be final.
- D. Where a proposed substitution involves the work of more than one (1) contractor, each contractor involved shall cooperate and coordinate the work with each other contractor involved, so as to provide uniformity and consistency and to assure the compatibility of products.
- E. Foreign Product Limitations: "Foreign products" as distinguished from "domestic products" are defined as products that are either manufactured substantially (50 percent or more of value) outside of the United States and its possessions, or produced or supplied by entities known to be substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.
 - 1. Except under one (1) of the following conditions, select and provide domestic, not foreign, products for inclusion in the Work.
 - a. There is no domestic product available that complies with the requirements of the Contract Documents.
 - b. Available domestic products that comply with the requirements of the Contract Documents are available only at prices or other procurement terms that are substantially higher (25 percent or more) than for available foreign products that comply with the requirements of the Contract Documents.
 - c. At the discretion of the Architect or Owner.
 - 2. Final determination and acceptance will be the responsibility of the Architect.
- F. Standards: Refer to Section 01 41 00, Regulatory Requirements for the applicability of industry standards to the products specified for the Project, and for the acronyms used in the text of the Specification Sections.

1.6 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least seven (7) days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Architect approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final
- E. The following are not considered as substitutions:
 - 1. Revisions to the Contract Documents, when requested by the Owner, Architect, or any of their consultants are considered as "changes" not substitutions.
 - 2. Specified Contractor options on products and construction methods included in Contract Documents are choices made available to the Contractor and are not subject to the requirements specified in this Section for substitutions.
 - 3. Except as otherwise provided in the Contract Documents, the Contractor's determination of and compliance with governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.
- F. The following may be considered as a reason for a request for substitution:
 - 1. The request is directly related to an "or approved equal" clause or similar language in the Contract Documents.
 - 2. The specified product or method of construction cannot be provided within the Contract Time in accordance with paragraph below concerning availability of specified items.
 - 3. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - 4. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other consideration of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Architect/Engineer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.
 - 5. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 - 6. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
 - 7. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
- G. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 - 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- H. A request constitutes a representation that Offeror:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

I. No substitutions will be considered after the Award of Contract.

1.7 SUBSTITUTION REQUEST SUBMITTAL

- A. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 2. Samples, where applicable or requested.
 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.
- B. Work-Related Submittals: The Contractor's submittal of, and the Architect/Engineer's acceptance of, Shop Drawings, Product Data, or Samples which are related to work not complying with the Contract Documents, does not constitute an acceptance or valid request for a substitution, nor approval thereof.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control to prevent overcrowding of construction spaces or overloading of structure. In particular, coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.
1. Deliver products to the site in the manufacturer's sealed containers or other packaging system, complete with labels intact, and instructions for handling, storage, unpacking, installing, cleaning and protecting.

2. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.
3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
4. Store products at the site or in a bonded and insured off-site storage facility or warehouse in a manner that will facilitate inspection and measurement of quantity or counting of units. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
5. Store heavy materials away from the project structure or in a manner that will not endanger the supporting construction.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCE

- A. General: Requirements for individual products are indicated in the Contract Documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one (1) of several different specifying methods, or in any combination of these methods. These methods include the following:
 1. Proprietary.
 2. Descriptive.
 3. Performance.
 4. Compliance with Reference Standards.
- B. Compliance with codes, compliance with graphic details, allowances, and similar provisions of the Contract Documents also have a bearing on the selection process
- C. Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the Contract Documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include, but are not limited to the following for the various indicated methods of specifying:
 1. Proprietary and Semi-Proprietary Specification Requirements:
 - a. Single Product Name: Where only a single product or manufacturer is named, provide the product indicated, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding, when it is discovered that the named product is not a reasonable or feasible solution.
 - b. Two (2) or More Product Names: Where two (2) or more products or manufacturers are named, provide one (1) of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. Do not provide or offer to provide an unnamed product, unless the specification indicates the possible consideration of other products. Advise the Architect/Engineer before proceeding where none of the named products comply with specification requirements, or are not feasible for use. Where products or manufacturers are specified by name, accompanied by the term "or approved equal" or similar language, comply with this Section regarding "substitutions" to obtain approval from the Architect/Engineer for the use of an unnamed product.
 2. Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with the Contract requirements.
 3. Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand name, provide products or assemblies that provide the characteristics indicated and otherwise comply with Contract requirements.

4. Performance Specification Requirements: Where the specifications require compliance with indicated performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.
 5. Compliance with Standards, Codes, and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including standards, codes, and regulations.
 6. Visual Matching: Where matching an established sample is required, the final judgement of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Architect. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of this Section regarding "substitutions" and other Contract Documents for "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.
 7. Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Architect is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.
 8. Allowances: Refer to individual sections of the specifications and Section 01 21 00, Allowances for an indication of product selections that are controlled by established allowances, and for the procedures required for processing such selections.
- D. Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Architect/Engineer's specification and the Contractor's selection of the product on the project is suitable and proper.

2.2 SUBSTITUTIONS

- A. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated.
- B. Anchor each product securely in place, accurately located and aligned with other work.
- C. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

- D. Products and assemblies shall be installed complete, in-place, watertight and structurally sound.

3.2 INSTALLATION OF APPROVED SUBSTITUTIONS

- A. Coordinate all approved substitutions with adjacent work.
- B. Comply with the manufacturer's and/or supplier's instructions and recommendations for installation of the products in the applications indicated.
- C. Provide all items required by manufacturer and/or supplier regarding installation, i.e. supplemental supports, anchors, fasteners, painting, etc. whether or not indicated or specified.

END OF SECTION 01 25 13

01 25 13.01 - REQUEST FOR SUBSTITUTION

Contract Award Date: _____

To: _____

Substitution Requested By: _____

Project Name and Number: _____

We submit for consideration the following product in lieu of the specified item for the above project:

Drawing No.	Specification Section	Paragraph	Specified Item
_____	_____	_____	_____

Proposed Substitution: _____

Request is made during ____ bidding ____ construction period.

Submit in accordance with Section 01 33 00.

1. Technical data, cost, and time information relating to changes to Construction Documents required by proposed substitution.
2. Detailed comparison of proposed substitution and specified product including but not limited to warranty, significant variations, qualifications of manufacturers, and maintenance.
3. Complete technical data, detailed shop drawings, samples, installation procedures, warranty, and substantiating data marked to indicate equivalent quality and performance to that specified. Manufacturer sell sheets are not acceptable submittals.

Cause for Request: _____

Cost saving realized by Owner _____

Does substitution affect adjacent Work, Construction Documents, cost, schedule, quality, and related submittals?

Yes ____ No ____ On separate sheet, explain affects to the Work, documents, schedule, and submittals.

The Contractor is responsible for associated costs and additional time of the proposed substitution including costs incurred by the Architect for evaluation of substitution and changes to the documents. Describe costs for changes to design, including engineering and detailing costs caused by the requested substitution.

Warranty: Is the warranty for the requested substitution the same or different? Yes ____ No ____

Explain Differences: _____

Contractor Certification:

In making a request for substitution, the Contractor certifies that:

1. The proposed substitution has been thoroughly researched and evaluated and determined as equivalent or superior to specified product or material, will fit into space provided, and is compatible with adjacent materials.
2. It will provide the same or better warranty for the proposed substitution at no additional cost to the Owner.

REQUEST FOR SUBSTITUTION

01 25 13.01 - 1

3. Cost data is complete and includes related costs under the Contract. Claims for additional costs related to the proposed substitution that may subsequently become apparent are waived.
4. It will assume the responsibility for delays and costs caused by the proposed substitution, if approved, are accepted by the Contractor unless delays are and costs are specifically mentioned and approved in writing by the Owner and the Architect.
5. It will assume the liability for the performance of the substitution and its performance.
6. The installation of the proposed substitution is coordinated with the Work and with changes required for the Work.
7. It will reimburse the Owner and Architect for evaluation and redesign services associated with the substitution request and, when required, by approval by governing authorities.

____ Has the substituted manufacturer/product been installed on previous PBK projects?

If so, list project(s): (List projects within the last two years)

1. _____
District: _____
Contact: _____
2. _____
District: _____
Contact: _____

Submitted by: _____

_____ Signature of Contractor			_____ Title
_____ Firm	_____ Telephone	_____ Date	

Signature shall be by the individual authorized to legally bind the Contractor's to the above terms. Failure to provide legally binding signature will result in retraction of approval.

FOR USE BY ARCHITECT:

____ Accepted ____ Accepted as Noted
____ Not Accepted ____ Received Too Late

By: _____

Date: _____

Remarks: _____

FOR USE BY OWNER:

____ Accepted ____ Not Accepted

By: _____

By: _____

Remarks: _____

END OF SECTION 01 25 13.01

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Work:
 - 1. Section 01 25 13 – Product Substitution Procedures.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 *Architect's Supplemental Instructions*.

1.4 PROPOSAL REQUESTS

- A. Owner Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop Work in progress or to execute the proposed change.
 - 2. After receipt of Proposal Request, submit quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include statement outlining reasons for the change and the effect of the change on the Work. Provide complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times,

- and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 13 if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use AIA Document G709.
- C. Contractor has ten (10) business days to submit pricing or submit resubmittal pricing to the Architect after issuance of a CPR or Change Proposal.
- D. Regardless of initiated change request pricing, a fully developed and completed change pricing to be submitted.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: When an allowance is specified, refer to Section 01 21 00 for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
1. Allowance Adjustment: To adjust allowance amounts, base each Change Proposal Request (CPR) on the difference between purchase amount and the allowance, multiplied by final measurement of Work in place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - a. Include installation costs in purchase amount only where indicated as part of the allowance.
 - b. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - c. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit cost allowances.
 - d. Owner reserves the right to establish the quantity of Work in place by independent quantity survey, measure, or count.
 2. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 7 days of receipt of the Change Order authorizing work to proceed. Owner will reject claims submitted later than 7 days after authorization.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will execute a Change Order also requiring signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work and designates the method to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of Work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PBK Architects
Project No. 240157

New CTE Center & Hargrave High School Additions & Renovations
Huffman Independent School District

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
- B. Pencil Copy: A preliminary review copy of the application for payment for review by Architect and Owner prior to submission of final copy.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Updated Submittal schedule.
 - c. Items required to be indicated as separate activities in updated Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect within 45 days of the Notice to Proceed. The Schedule of Values will be reviewed by both the Architect and Program Manager until approved. No application for payment will be approved until the Schedule of Values is approved. Contractor's standard form or electronic media printout will be considered but must be approved by the Owner.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.

- g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment rentals.
 - 4) General Conditions.
 - a. Supervisor.
 - b. Submittals.
 - c. Close-out.
 - d. Field Engineering.
 - e. Daily Clean-up.
 - f. Final Clean-up.
- 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- 5. Provide separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on site and items stored off site. Include evidence of insurance.
- 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line item value of unit cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- 7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual Work in place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
- 8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Submit preliminary (pencil) copy of proposed values to Architect or Architects field representative and Owner for review by 20th date of the month. Allow 48 hours for comments.
- B. Once preliminary (pencil) approved, submit electronic copy of notarized originals of each application on AIA Form G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702 or other similar form approved by the Owner.
- C. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- D. Submit updated construction or recovery schedule with each Application for Payment.
- E. Payment Period: Submit at intervals stipulated in the Agreement in accordance with Document 00 73 00, Supplementary Conditions of the Contract.
- F. Only materials stored on the project site shall be paid for unless the materials are stored in a bonded warehouse where stored materials are being requested for approval, all required items are included but a minimum, there is proof of specific insurance noting serial numbers, photographs, physical address, a statement that there is no additional charge or schedule impact from this process, and proof of approval is attached to the final approved application.

- G. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Items which may be requested by the Architect or Owner to substantiate costs include, but are not limited to the following:
1. Current Record Documents as specified in Section 01 77 00, Closeout Procedures maintained.
 2. Labor time sheets, purchase orders, or similar documentation.
 3. Affidavits attesting to off-site stored products.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 29 00

SECTION 01 29 73 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. Work Included: Provide a detailed breakdown of the agreed Contract Sum showing values allocated to each of the various parts of the work, as specified herein and in other provisions of the Contract Documents.
- B. Coordinate requirements of this Section with the requirements of the General and Supplementary Conditions of the Contract concerning Schedule of Values.

1.3 QUALITY ASSURANCE

- A. Use required means to assure arithmetical accuracy of the sums described.
- B. When so required by the Owner, provide copies of the subcontracts or other data acceptable to the Owner, substantiating the sums described.

1.4 SUBMITTALS

- A. Prior to the first Application for Payment, submit a proposed schedule of values to the Owner, as outlined below:
 - 1. Meet with the Owner and determine additional data, if any, required to be submitted.
 - 2. Secure the Owner's approval of the schedule of values prior to submitting first Application for Payment.

1.5 SCHEDULE OF VALUES

- A. The Schedule of Values shall be broken down into item costs for each specification section as a minimum. After review by the Owner, the Schedule of Values shall be broken down into further items as required. (See following list and refer to the enclosed sample.). In addition, total each Specification Division separately.
- B. Schedule of Values - Items in addition to Specification Sections.
 - 1. Mobilization
 - 2. Clean Up
 - 3. Building Permit
 - 4. Bonds, Insurance
 - 5. Misc. Mechanical Accessories
 - 6. Demolition
 - 7. Rough-In Labor - (Electrical)
 - 8. Rough-In Material - (Electrical)
 - 9. Finish Labor - (Electrical)
 - 10. Finish Material - (Electrical)
 - 11. Allowances (listed separately)
 - 12. Record drawings and close-out documents
 - 13. Submittals listed separately per mechanical, electrical and plumbing
 - 14. Roof warranty as a line item

15. Donated items individually itemized at \$0.00 (zero dollars).

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

- A. Refer to following sample.

END OF SECTION 01 29 73

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Div. 1 - General Reqs. Site Work General Conditions Supervision Mobilization Bonds & Insurance Permits Contractor's Fee Close-Out Documents								
	Div. 1 - Total								
	Div. 2 - Existing Conditions Demolition (As applicable) Erosion Control Div. 2 - Total								
	Div. 3 - Concrete Drill Piers Caps & Beams Slab on Grade Cooling Tower Basin Misc Bldg Conc Floor Sealer Rebar Matl Rebar Labor Lt.Wt.Insul Fill - Materials Lt.Wt.Insul Fill - Labor Submittals/Close-Out Documents Supervision Clean-up								
	Div. 3 - Total Div 4 - Masonry Brickwork - Labor Brickwork - Matls Concrete Masonry - Labor Concrete Masonry - Materials Str. Glazed Tile-Labor Str. Glazed Tile-Materials Submittals/Close-Out Documents Supervision Clean-up								
	Div. 4 - Total								
	Div 5 - Metals Structural Steel - Labor Structural Steel - Materials Alternating Stairs Misc. Steel - Materials Steel Joists - Materials Lt. Gauge Steel Framing-Labor Lt. Gauge Steel Framing-Matls Metal Decking - Labor Expansion Joint Covers Metal Decking - Matls								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Detailing Submittals/Close-Out Documents Supervision Clean-up								
	Div. 5 - Total								
	Div. 6 - Wood & Plastics Rough Carpentry - Labor Rough Carpentry - Materials Millwork - Labor Millwork - Materials Submittals/Close-Out Documents								
	Div. 6 - Total								
	Div. 7 - Thermal and Moisture Protection Waterpfng / Dampprfng-Matls Waterpfng / Dampprfng-Labor Building Insulation - Labor Building Insulation - Materials Fireproofing - Labor Fireproofing - Materials Metal Roof - Labor Metal Roof - Materials Metal Roof Guarantee Built-up Roofing-Labor Built-up Roofing-Materials Built-up Roofing Guarantee Roof Accessories Building Sheet Metal - Labor Building Sheet Metal - Matls Bldg. Sheet Metal Guarantee Roof Curbs Roof Hatches Sealants Submittals/Close-Out Documents Supervision Clean-up								
	Div. 7 - Total								
	Div. 8 - Doors and Frames Finish Carpentry/Door - Labor Finish Hardware - Matls Thresholds & Seals - Matls+B66 Hollow Metal Doors & Frames - Matls Plastic Faced Doors-Matls Overhead Doors & Grilles-Labor Overhead Doors & Grilles - Matls Alum. Entrances & Store-fronts - Labor Alum. Entrances & Store-								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	fronts - Matls Alum. Windows - Labor Alum Windows - Matls Glass & Glazing-Labor Glass & Glazing-Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 8 - Total								
	Div. 9 - Finishes Lath & Plaster-Labor Lath & Plaster-Matls Gypsum Wallboard Systems - Labor Gypsum Wallboard Systems - Matls Ceramic Tile - Labor Ceramic Tile - Matls Quarry Tile - Labor Quarry Tile - Matls Terrazzo-Labor Terrazzo-Matls Acoustic Clg. - Labor Acoustic Clg. - Matls Acoustic Wall Panels Resilient Flooring - Labor Resilient Flooring - Matls Carpet - Labor Carpet - Matls Athletic Flooring - Materials Athletic Flooring - Labor Floor Sealer Painting - Labor Painting - Mtls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 9 - Total								
	Div. 10 - Specialties Visual Display Boards & Tackboards - Materials Visual Display Boards & Tackboards - Labor Toilet Partitions - Labor Toilet Partitions - Matls Louvers Aluminum Flag Pole Graphics Lockers Cubicle Curtains & Track Fire Extinguisher Cabinets Demountable Partitions-Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Demountable Partitions-Matls Shelving Toilet Room Accessories-Matls Toilet Room Accessories-Lbr Submittals/Close-Out Documents Supervision Clean-up								
	Div. 10 - Total								
	Div. 11 - Equipment Stage Curtains Misc. Appliances Food Service Eqpt-Labor Food Service Eqpt-Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 11 - Total								
	Div. 12 - Furnishings Horizontal Blinds Projection Screens Casework - Labor Casework - Matls Science Casework - Labor Science Casework - Matls Submittals/Close-Out Documents Supervision Clean-up								
	Div. 12 - Total								
	Div. 13 - Specialties Stage Curtains and Draperies Music Instrument Storage Bleachers Press Box Pre-eng. Metal Bldg. Stadium Seating Submittals/Close-Out Documents Supervision Clean-up								
	Div. 13 - Total								
	Div. 14 - Conveying Systems Platform Lifts Elevators Submittals/Close-Out Documents Supervision Clean-up								
	Div. 14 - Total								
	Div. 21, 22 - Plumbing Shop Drawings As-Builts/Close-Out/ O&M Manuals Sanitary Underground -								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Labor Sanitary Underground - Matls Storm Underground - Labor Storm Underground - Matls Domestic Water - Labor Domestic Water - Matls Plumbing Insulation - Matls Plumbing Insulation - Labor Gas Piping - Matls Gas Piping - Labor Grease Trap Plumbing Fixtures - Matls Plumbing Fixtures - Labor Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	Div. 21, 22 Plumbing - Total								
	Div. 23 - Mechanical Shop Drawings As-Built/Close-Out/ O&M Manuals Chillers - Matls Chillers - Labor Cooling Towers - Matls Cooling Towers - Labor Boilers - Matls Boilers - Labor AHU's - Matls AHU's - Labor Fans - Matls Fans - Labor Grilles - Matls Grilles - Labor Ductwork - Matls Ductwork - Labor Pumps - Mtls Pumps - Labor Water Treatment - Labor Water Treatment - Matls Isolation - Labor Isolation - Matls Pipe Flex - Matls Pipe Flex - Labor Connections Sheet Metal - Matls Sheet Metal - Labor Duct Insulation - Matls Duct Insulation - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Pipe Insulation - Matls Pipe Insulation - Labor VAV Boxes - Materials VAV Boxes - Labor Refrigerant Monitor - Matls Refrigerant Monitor - Labor Unit Heaters - Materials Unit Heaters - Labor Startup Controls - Matls Control - Labor Engineer / Submittals Modules / End Devices Low Voltage Wiring Startup Close-Out Documents Fire Sprinkler Engineer / Submittals Piping - Materials Piping - Labor Equipment - Materials Equipment - Labor Trimout - Materials Trimout - Labor Pipe, Valves, Fittings - Labor Pipe, Valves, Fittings - Matls Misc. - Matls Insulation - Matls Insulation - Labor Sanitary Above Slab-Labor Sanitary Above Slab-Matls Storm Above Slab - Labor Storm Above Slab - Matls Gas - Labor Gas - Matls Fixtures - Labor Fixtures - Matls Permits Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	Div. 23 Mechanical - Total								
	Div. 26 - Electrical								
	Mobilization+B220 Shop Drawings As-Builts/Close-Out/ O&M Manuals Underground Conduit - Labor Conduit - Matl Wire - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Wire - Matls Feeder Wire - Labor Feeder Wire - Matls Switches/Recpt. Switchgear - Labor Switchgear - Matls Temporary - Materials Temporary - Labor Gas Generator - Materials Gas Generator - Labor Fixtures - Labor Fixtures - Matls Communications - Labor Communications - Matls Fire Alarm - Labor Fire Alarm - Matls Security - Labor Security - Matls Low Voltage Ltng Sys-Matls Low Voltage Ltng Sys-Labor Voice System - Materials Voice System - Labor Video System - Materials Video System - Labor Data System - Materials Data System - Labor Master Clock - Materials Master Clock - Labor+B277 Coordination Drawings Submittals/Close-Out Documents Supervision Clean-up								
	Div. 26 - Total								
	Divs. 31, 32 and 33 - Earthwork, Exterior Improvements and Utilities								
	Site Clearing & Grubbing Building Pad - Materials Building Pad - Labor Paving Subgrade Signage / Striping Bike Racks Landscaping - Materials Landscaping - Labor Hydro Mulch - Materials Hydro Mulch - Labor Irrigation - Materials Irrigation - Labor Earthwork Finish Grading Stabilization - Materials Stabilization - Labor Site Drainage - Materials Site Drainage - Labor								

SECTION 01 29 73

SCHEDULE OF VALUES - SAMPLE

Item No.	Description of Work	Scheduled Value	Work Completed		Stored Materials	Total Completed	%	Balance To Finish	Retainage
			Previous App.	This App.					
	Chain Link Fence-Materials Chain Link Fence-Labor Paving - Labor Paving - Materials Sidewalks Submittals/Close-Out Documents Supervision Clean-up								
	Div. 31, 32 and 33 - Total								
	General Conditions Mobilization Temp. Facilities Final Cleaning Record Documents/Close-out/ O&M Manuals Supervision Permits Bonds Insurance Allowances Alternates (list) Change Orders A. PR# B. PR# C. PR#								

END OF SECTION

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Pre-install meetings.
- B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific Contractor.
- C. Contractor shall make a reasonable attempt to interpret the Contract Documents before asking the Architect for assistance in interpretation. Requests for Information (RFI's) will not be allowed from the Contractor. The Contractor shall arrange the necessary meeting in the field with appropriate Architect's field representative(s) to obtain clarification as needed on items that may need interpretation.

1.3 SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. Coordination: Each Contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations, included in different Sections, which depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other Contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate Contractors if coordination of the Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
 - 9. Coordinating inspections and other jurisdictional requirements.
 - 10. Coordinate OFCI equipment.
 - 11. Action items and issue logs.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to the Specifications Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade specific information to the coordination drawings by multiple Contractors in sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings:
- 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures, ductwork, piping, and other components.
 - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire-alarm, and electrical equipment.
 - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 - 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - e. Floor boxes.
 - 8. Fire Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, sprinkler heads, and inspector test locations.
 - 9. IDF/MDF Rooms: Communications and low voltage (security, data, phone, etc.) audio
 - 10. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

11. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Revit.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 PROJECT MEETINGS

- A. Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Architect to prepare the meeting agenda and distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
 4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
 5. Issue logs: Documentation element of software project management and contains a list of ongoing and closed issues of the project.
- B. Kick-off & Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that affect progress.
 4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- C. Preinstallation Conferences: Conduct a preinstallation trade conference at site before each construction activity that requires coordination with other construction trades.
 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Engineer of Record of scheduled meeting dates.
 2. Agenda: Contractor to review progress of other construction activities and preparations for the particular activity under consideration.
 3. Contractor to record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Contractor to distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
 6. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
 7. The District and the Program Manager shall be notified at least 48 hours in advance prior to the following Preinstallations and Milestones:
 - a. Below grade rough-in
 - 1) Electrical mains, all under slab distribution.
 - 2) Plumbing mains and in ground valves.
 - b. Above ground rough-in
 - 1) Main distribution of all utilities.
 - 2) In wall piping and wiring of all utilities.
 - 3) Built rack supports.
 - 4) Prior to wall close up.
 - 5) Prior to ceiling close up.
 - 6) Prior to any remaining concealed space cover up.
 - c. Pre-installation conference with Sub-contractors
 - 1) All major disciplines
 - a) Concrete
 - b) Mechanical
 - c) Electrical
 - d) Plumbing
 - e) Technology
 - f) Instructional Technology
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Substantial Completion.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
 - b. Six (6) week look-ahead schedules.
 5. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.
- F. Coordination Meetings: Conduct coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each Contractor present.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
 4. Action Items: An element of work, design, research, or other task to be completed before a specific date or time, such as before a subsequent meeting of involved parties.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's construction schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Special reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for completion of an activity as scheduled.
- G. Recovery Schedule: Submittal of a revised critical path method (CPM) schedule and a written plan.
- H. Look-ahead Schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update.

- I. Milestones: Measurable and observable and serve as progress markers (flags) but, by definition, are independent of time (have zero durations) therefore no Work or consumption of resources is associated with them.

1.4 SUBMITTALS

- A. Submittal Format: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Startup Diagram: Of size necessary to display entire network for entire construction period. Show logic relationship ties for all activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at monthly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Special Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at site. Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including phasing, Work stages, area separations, interim milestones, and partial Owner occupancy.
 - 4. Review delivery dates for Owner furnished products.
 - 5. Review schedule for Work of Owner's separate contracts, if any.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Time is of the essence to the Owner. Commence Work immediately upon issuance of the Notice to Proceed. There is a critical need for the Work to be substantially complete within the time frame identified in the Agreement.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and date of final completion.
 - 1. Contract completion date shall not be changed by submission of schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each separate area or story as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities in terms of number of days anticipated.
 - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 4. Startup and Testing Time: Include number of days anticipated for startup and testing.
 - 5. Substantial Completion: Indicate completion of all conditions as in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 6. Punch List and Final Completion: Include a maximum of 30 days for completion of punch list items and final completion.
 - 7. Inspections required by Authorities Having Jurisdiction (AHJ).
- D. Constraints: Include constraints and Work restrictions indicated in the Contract Documents and show how the sequence of the Work is affected.
 - 1. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.
 - b. Mockups.
 - c. Fabrication.
 - d. Installation.
 - e. Tests and inspections.
 - f. Adjusting.
 - g. Curing.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- F. Six (6) week, lookahead schedule: Prepare schedule indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
 6. Inspections by Authorities Having Jurisdiction (AHJ).
 7. Trade pre-installation conference.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- I. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time impact analysis to demonstrate the effect of the proposed change on the overall project schedule.
- J. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

2.2 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording information concerning events at the site and submit each month to Architect:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Rental equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (see special reports).

10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of Authorities Having Jurisdiction (AHJ).
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report and contact Architect Field Representative. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents to Architect Field Representative.
- D. Special Reports: Submit special reports directly to Owner within 24 hours of an occurrence. Distribute copies of report to parties affected by the occurrence.
1. Reporting Unusual Events: When an event of an unusual and significant nature occurs at site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner & Architect in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule with a pencil copy of pay application.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and interested parties identified by Contractor with a need to know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

- A. Submittals: Written and graphic information and physical samples that require Architect's responsive action or are for information and do not require the architect's action.
- B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- C. Portable Document Format (PDF): An open standard file format used for representing documents in a device independent and display resolution independent fixed layout document format.

1.4 SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Upon request, Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in Revit.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
 - d. The following digital data files will be furnished for each appropriate discipline:

- 1) Floor plans.
 - 2) Reflected ceiling plans.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow ten (10) days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process in same manner as initial submittal.
 3. Resubmittal Review: Allow ten (10) days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow ten (10) days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 3. Transmittal Form for Electronic Submittals: Use software generated form from electronic project management software acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.

- n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
- 4. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. Program Manager to be copied on all Submittal reviews.
- B. Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Certificates and Certifications Submittals: Provide statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

- C. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in PDF electronic file.
- D. Shop Drawings: Prepare Project specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full size drawings, submit Shop Drawings on sheet size indicated in specification section.
 3. Submit Shop Drawings in PDF electronic file.
 4. BIM File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.
 - a. Prepare Shop Drawings in same digital data software program, version, and operating system as the original Drawings.
 - b. Refer to Section 01 31 00 for requirements for coordination drawings.
- E. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.

- d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
- 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
- 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- 5. Samples: Submit full size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- F. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.
 - 4. Location within room or space.
 - 5. Submit product schedule in PDF electronic file.
- G. Coordination Drawing Submittals: Comply with requirements specified in Division 01.
- H. Contractor's Construction Schedule: Comply with requirements specified in Division 01.
- I. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00.
- J. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00.
- K. Closeout Submittals required for Substantial Completion: Comply with requirements specified in Section 01 77 00.
- L. Maintenance Data: Comply with requirements specified in Section 01 78 23.

- M. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- N. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- Q. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- R. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- X. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

- Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM File Incorporation: Incorporate delegated design drawing and data files into Building Information Model established for Project.
 - 1. Prepare delegated design drawings in the same digital data software program, version, and operating system as the original Drawings.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are not permitted, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents will be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 35 16 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Special procedures for alteration Work.

1.3 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of Work to be matched; it may be existing Work or Work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration Work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration Work.
 - 1. Schedule construction operations in sequence required to obtain best Work results.
 - 2. Coordinate sequence of alteration Work activities to accommodate the following:
 - a. Owner's continuing occupancy of portions of existing building.

- b. Owner's partial occupancy of completed Work.
 - c. Other known Work in progress.
 - d. Tests and inspections.
 - 3. Detail sequence of alteration Work, with start and end dates.
 - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 - 5. Use of elevator and stairs.
 - 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration Work with circulation patterns within Project building(s) and site. Some Work is near circulation patterns. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of Work. Access to restricted areas may not be obstructed. Plan and execute the Work accordingly.

1.5 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before commencing alteration Work, conduct conference at site.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration Work at regular intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 - 1. Review items of significance that affect progress of alteration Work.
 - a. Interface requirements of alteration work with other Project Work.
 - b. Status of submittals for alteration Work.
 - c. Access to alteration work locations.
 - d. Effectiveness of fire prevention plan.
 - e. Quality and work standards of alteration Work.
 - f. Change Orders for alteration Work.
 - 2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.
 - 1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed.
- B. Alteration Work Subschedule: Submit alteration Work subschedule within seven days of date established for commencement of alteration Work.
- C. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration Work operations.
- D. Alteration Work Program: Submit 30 days before Work begins.
- E. Fire Prevention Plan: Submit 30 days before Work begins.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with the IBC and the IEBC for alteration Work.
 - 2. Fire Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire control devices during each phase or process. Coordinate plan with Owner's fire protection equipment and requirements. Include fire watch personnel's training, duties, and authority to enforce fire safety.
 - 3. Safety and Health Standard: Comply with ANSI/ASSE A10.6.
 - 4. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a *Lead-Safe Certified Firm* according to 40 CFR 745, Subpart E, and use only workers that are trained in lead safe Work practices.
 - 5. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS).
- B. Specialist Qualifications: An experienced firm having minimum 10 years documented experience that is regularly engaged in specialty Work similar in nature, materials, design, and extent to alteration Work specified.
 - 1. Field Supervisor Qualifications: Full time supervisors experienced in specialty Work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on site when specialty Work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
 - a. Construct new mockups of required Work whenever a supervisor is replaced.
- C. Alteration Work Program: Prepare a written plan for alteration Work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole Project alteration Work program with specific requirements of programs required in other alteration Work Sections.
 - 1. Dust and Noise Control: Include locations of proposed temporary dust and noise control partitions and means of egress from occupied areas coordinated with continuing on site operations and other known Work in progress.
 - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

1.8 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
 - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
 - 1. Repair and clean items for reuse as indicated.
 - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
 - 3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction Work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction Work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
 1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 2. Secure stored materials to protect from theft.
 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 degrees F (3 degrees C) or more above the dew point.
- E. Storage Space:
 1. Arrange for off site locations for storage, protection, and insurance coverage of salvaged material that cannot be stored and protected on site.

1.9 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of **preconstruction photographs**.
 1. Comply with requirements specified in Section 01 32 30.
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling Work.
- C. Owner's Removals: Before beginning alteration Work, verify in correspondence with Owner that the following items have been removed:
- D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration Work.
 1. Use proven protection methods, appropriate to each area and surface being protected.
 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration Work is being performed.
 3. Erect temporary barriers to form and maintain fire egress routes.
 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration Work.
 5. Contain dust and debris generated by alteration Work, and prevent it from reaching the public or adjacent surfaces.

6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 8. Provide supplemental sound control treatment to isolate demolition Work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration Work before commencing operations.
 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration Work.
 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of Work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin Work in an area until the drainage system is functioning properly.
1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration Work.
 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of Work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

- A. Follow fire prevention plan and the following:
1. Comply with NFPA 241 requirements unless otherwise indicated.
 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate Work.
 - a. If combustible material cannot be removed, provide fire blankets to cover materials.
- B. Heat Generating Equipment and Combustible Materials: Comply with procedures while performing Work with heat generating equipment or combustible materials, including welding, torch cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. Obtain Owner's approval for operations involving use of welding or other high heat equipment. Use of open flame equipment is not permitted. Notify Owner at least 72 hours before each occurrence, indicating location of such Work.
 2. As far as practicable, restrict heat generating equipment to shop areas or outside the building.

3. Do not perform Work with heat generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before Working with heat generating equipment or combustible materials, station personnel to serve as a fire watch at each location where Work is performed. Firewatch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire control equipment and alarms.
 - b. Prohibit firewatch personnel from other Work that would be a distraction from firewatch duties.
 - c. Cease Work with heat generating equipment whenever fire watch personnel are not present.
 - d. Have fire watch personnel perform final fire safety inspection each day beginning no sooner than 30 minutes after conclusion of Work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire watch personnel at each area of site until 60 minutes after conclusion of daily Work.
- C. Fire Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each Work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
1. Remove temporary guards at the end of Work shifts, whenever operations are paused, and when nearby Work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration Work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 ALTERATION WORK

- A. Have specialty Work performed only by qualified specialists.

- B. Ensure that supervisory personnel are present when Work begins and during its progress.
- C. Record existing Work before each procedure (preconstruction), and record progress during the Work. Use digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 01 32 33.
- D. Perform surveys of site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the Work in question until directed by Architect.

END OF SECTION 01 35 16

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality assurance and quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality assurance and quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full size physical assemblies constructed at testing facility to verify performance characteristics.
 - 2. Integrated Exterior Mockups: Mockups of exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality Control Testing: Tests and inspections performed on site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform particular construction operations, including installation, erection, application, and similar operations.
 - 1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, *experienced* means having successfully completed a minimum of five years documented experience with projects similar in nature, size, and extent; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 SUBMITTALS

- A. Shop Drawings: Submit plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting Work on the following systems:
 - 1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by Architect.
 - 2. Main wind force resisting system or wind resisting component listed in the wind force resisting system quality assurance plan prepared by Architect.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.

4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality control service.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- E. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.7 QUALITY ASSURANCE

- A. Qualifications establish the minimum qualification levels required; refer to individual Specification Sections for additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated and sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated and with record of successful in service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling Work similar in material, design, and extent to that indicated for this Project, whose Work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Texas, experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products.
- I. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit certified written report of each test, inspection, and similar quality assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect a minimum of seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's approval of mockups before starting Work, fabrication, or construction. Allow **seven** days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Mockup of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies shall be constructed. Mockup, if not specifically shown on the drawings, shall be minimum 8'x8'. Mockup shall include all major façade elements and at least one window minimum 2'x2' in size. Prior to constructing mockup verify requirements with architect. Pre-installation conferences for trades involved in Integrated Exterior Mockup shall be held after mock up is completed.
- M. Interior Classroom Mockup: Provide for District approval, one classroom and one wet lab mock up full rough-in of all wall devices and blocking for review prior to proceeding with the remainder of work.
- N. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.
- O. Trade Preinstallation Conferences: Meeting minutes to be Contractor provided.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform the services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform the quality control services. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory authorized service representative to inspect field assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300.
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.9 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner:
- B. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.
 1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00.
- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

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Huffman Independent School District

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK REQUIREMENTS

- A. General: This Section specifies procedural and administrative requirements for compliance with governing regulations and codes and standards imposed upon the Work. These requirements include the obtaining of permits, licenses, inspections, releases, and similar statements, as well as payments, associated with regulations, codes, and standards.
- B. "Regulations" is defined to include laws, statutes, ordinances, and lawful orders issued by governing authorities, as well as those rules, conventions and agreements within the construction industry which effectively control the performance of the Work regardless of whether they are lawfully imposed by governing authority or not.
- C. Governing Regulations: Refer to General and Supplementary Conditions for requirements related to compliance with governing regulations.

1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized", "selected", "required", and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown", "noted", "scheduled", and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

- J. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.4 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Individual Specification Sections indicate which codes and standards the Contractor must keep available at the project site for reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Conflicting Requirements: Where compliance with two or more standards is specified, and where these standards establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents specifically indicate a less stringent requirement. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect/Engineer for a decision before proceeding.
- D. Minimum Quantities or Quality Levels: In every instance the quantity or quality level shown or specified is intended to be the minimum for the Work to be provided or performed. Unless otherwise indicated, the actual Work may either comply exactly, within specified tolerances, with the minimum quantity or quality specified, or may exceed that minimum within reasonable limits. In complying with these requirements, the indicated numeric values are either minimum or maximum values, as noted, or as appropriate for context of the requirements. Refer instances of uncertainty to the Architect/Engineer for decision before proceeding.

1.5 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction or other entity applicable to the context of the text provision.
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the Agency.
- C. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations.

1.6 SUBMITTALS

- A. Permits, Licenses and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS

Not Used

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Project No. 240157

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PART 3 - EXECUTION

Not Used

END OF SECTION 01 42 00

SECTION 01 45 23 – STRUCTURAL TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. The testing laboratory shall make all inspections and perform all tests in accordance with the building code, local authorities, ASTM specifications and the Contract Documents.
- B. The testing laboratory shall provide as a part of the project's close-out documents or as required by any regulatory authority, all appropriate signed and sealed Special Inspection Certificates whose purpose would be to provide consistency and direction for compliance with the referenced Building Code. These Special Inspection Certificates shall confirm that that all work requiring special inspection has been adequately performed, and the special inspections have been made by an individual or firm that is qualified to make special inspections per the referenced Building Code.
- C. Materials and workmanship not meeting the required standards are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.
- D. Testing, inspection, and certifications specified in other sections of these Specifications shall be paid by the Owner, unless otherwise indicated.
- E. Inspection by the laboratory shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

1.3 REFERENCED STANDARDS

- A. The latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise.
- B. ACI 311 – ACI Manual of Concrete Inspection
- C. ACI 301 - Specification for Structural Concrete
- D. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY ASSURANCE

- A. Testing Laboratory shall meet the requirements of ASTM E329 and ASTM E543.
- B. Testing Laboratory shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than \$500,000.

- C. Testing Laboratory shall be under the direction of a Registered Engineer who is legally authorized to practice in the jurisdiction where Project is located and having at least five years experience in inspection and testing of construction materials.
- D. Laboratory staff monitoring concrete work shall be ACI certified inspectors.
- E. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The work of the assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.
- F. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.5 LABORATORY RESPONSIBILITIES

- A. Attend preconstruction meetings and progress meetings as required to coordinate work with the Contractor and address quality control issues.
- B. Test samples of design mixes submitted by Contractor.
- C. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
- D. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.
- E. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- F. Promptly notify Architect/Engineer and Contractor of observed irregularities or non conformance of Work or Materials.
- G. Perform all inspections and tests in accordance with building code requirements for "Special Inspection" whether or not such inspections are specified in the Contract Documents.
- H. Testing Laboratory shall write a letter at the completion of the project, signed, and sealed by a registered engineer in the state of the project, summarizing the inspections performed, the dates they were performed, and whether the observed construction complied with the Contract Documents.

1.6 LABORATORY REPORTS

- A. After each inspection and test, promptly submit copies of laboratory reports to Architect, Engineer, Owner and to Contractor.
- B. Include:

1. Date issued
2. Project title and number
3. Name of inspector
4. Date and time of sampling or inspection
5. Identification of product and specifications section
6. Location in the Project
7. Type of inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge the requirements of the Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work, except where such approval is specifically called for in these specifications.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES

- A. See technical sections of these specifications for specific requirements.
- B. Deliver to the laboratory, without cost to the Owner, adequate samples of materials proposed for use which are required to be tested.
- C. Advise laboratory sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.
- D. Provide facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing as required by ASTM specifications C31.
- E. Provide incidental labor and equipment as required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.
- F. Furnish concrete mix designs, in accordance with ACI 301, section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs are required, the laboratory shall be selected and paid by the Contractor.
- G. Provide current welder certifications for each welder to be employed.
- H. Furnish fabrication and erection inspection of all welds in accordance with AWS D1.1, Chapter 6.
- I. Prequalification of all welding procedures to be used in executing the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PIER DRILLING

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The laboratory representative shall make continuous inspections to determine that the proper bearing stratum is obtained and that shafts are clean and dry before placing concrete.
- C. The laboratory shall furnish complete pier log showing the diameter, top and bottom elevations of each pier, whether or not casing is required, bell size (if required), actual penetration into bearing stratum, and elevation of top of bearing stratum.

3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.
- B. Observe and report on the following:
 - 1. Number and size of bars
 - 2. Bending and lengths of bars
 - 3. Splicing
 - 4. Clearance to forms including chair heights
 - 5. Clearance between bars or spacing
 - 6. Rust, form oil, and other contamination
 - 7. Grade of Steel
 - 8. Securing, tying and chairing of bars
 - 9. Excessive congestion of reinforcing steel
 - 10. Installation of anchor bolts and placement of concrete around anchor bolts
 - 11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 - 12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents
- C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in projects of similar size.

3.3 REINFORCING STEEL MECHANICAL SPLICES

- A. Each mechanical splice shall be visually inspected to ensure compliance with the ICBO Reports and the manufacturer's published criteria for acceptable completed splices.
- B. Special emphasis shall be placed on inspection of the end preparation of each bar to be spliced, as required by the ICBO report.

- C. Reports on each mechanical splice shall indicate location of the splice, size of bars spliced, and whether splice is accepted or rejected. Reasons for rejection shall be shown on each report.

3.4 CONCRETE INSPECTION AND TESTING

- A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.
- B. Mold and cure specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.
- C. Test specimens in accordance with ASTM C39. Two specimens shall be tested 7 days, two specimens shall be tested at 28 days for strength acceptance. A spare cylinder shall be made and kept for a 56-day break if the 28-day break does not meet strength requirements. If the plans require 56-day break (such as for mass concrete), two samples shall be tested at 56 days for acceptance.
- D. Make one strength test (four or five cylinders) for each:
 - 1. 100 cubic yards or fraction thereof, of each mix design placed in one day.
 - 2. OR, for each 5000 sq. ft. of slab area placed in one day.
 - 3. When the total quantity of a given class of concrete is less than 25 cu. yds., the strength tests may be waived by the Architect/Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.
- E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.
- F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.
- G. Determine air content and unit weight of lightweight concrete sample for each strength test in accordance with ASTM C173 and ASTM C567.
- H. Determine temperature of concrete sample for each strength test and one test for each concrete load discharged when air temperature is 80 degrees F. and above.
- I. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design and the project requirements to the Architect, the Contractor, and the Concrete Supplier.
- J. Monitor the slump and air content of the concrete. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the project requirements and specifications and shall be rejected.

- K. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.
- L. Laboratory reports shall contain the following information:
 - 1. Class of concrete and specific location.
 - 2. Specified strength of concrete.
 - 3. Air temperature.
 - 4. Batch time.
 - 5. Specified time that discharge of concrete must be completed, based on air temperature.
 - 6. Time concrete is placed.
 - 7. Amount of water withheld at the plant for latter addition at the project site (Note that the total amount of water shall not exceed the maximum water/cement ratio for the approved mix design).
 - 8. Amount of water added at the site.
 - 9. Allowable slump range on the approved mix design.
 - 10. Slump.
 - 11. Maximum and minimum allowable concrete temperature on the approved mix design.
 - 12. Temperature of the concrete mix.
 - 13. Air content range on the approved mix design.
 - 14. Air content.
 - 15. Statement that concrete is in compliance with the project documents and the approved mix designs.
- M. Evaluation and Acceptance:
 - 1. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.
 - 2. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Buildings," ACI 301 have been met.
- N. Observe the placing of all concrete, except site work. Observe and report on placing method, consolidation, cold joints, length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.
- O. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).
- P. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Architect.

3.5 MASONRY

- A. Inspection

1. Provide a qualified inspector to inspect all structural masonry work.
 - a. Inspect masonry for compliance in accordance with the "Level 1 or 2 Special Inspection" provisions of the building code. Refer to the contract documents regarding which level of special inspections is required.
 2. In combination with inspections required by the building code, inspect the following:
 - a. Preparation of masonry prisms for testing.
 - b. Placement of reinforcing.
 - c. Cavities to be grouted (prior to grouting and prior to closing cleanouts).
 - d. Mortar mixing operations, including proportion of materials and method of measuring materials (materials should be measured with a mixing box and not a shovel).
 - e. Bedding of mortar for each type of unit and placing of units.
 - f. Grouting operations.
 - g. Condition of units before laying for excessive absorption.
 3. Provide report of each inspection.
- B. Field Compressive Tests for Grout:
1. Secure composite samples of grout at the jobsite in accordance with ASTM C 1019.
 2. Mold and cure three specimens from each sample in accordance with ASTM C 1019. Supervise the curing protection provided (by others) for test specimens in the field and the transportation from the field to the laboratory. The test specimens shall be stored in the field 24 to 48 hours and then be carefully transported to the laboratory and cured in accordance with ASTM C 1019.
 3. Test specimens in accordance with ASTM C 1019. Two specimens shall be tested at 28 days for acceptance and one specimen shall be tested at 7 days for information.
 4. Make one strength test (three specimens) for each 10 cubic yards of grout poured but not less than one strength test for each 5000 square feet of wall area.
- C. Prism Tests:
1. Build prisms at the jobsite using the same materials and methods as being used for the wall construction. Store prisms in a place where they will be undisturbed for two days and have approximately same curing conditions as masonry construction. After 48 hours, move prisms to the laboratory and test in accordance with ASTM C1314.
 2. Make prism tests in advance of operations using materials under same conditions, with the same bonding and construction methods as is being used for the structure. When building prisms, moisture content of the units at time of laying, consistency of mortar and width and thickness of mortar joints shall be same as used in the structure.
 3. Build prisms of hollow masonry units the same width as unit by 16" long by 16" high. Apply mortar to face shells only. Do not fill hollow core with grout. Compute value of ultimate net compressive strength, by dividing ultimate load by net face shell area of masonry units.
 4. Cure and test prisms in accordance with applicable provisions of ASTM C1314. Test five specimens of each type of masonry unit before delivering material to the jobsite and submit results for approval. During construction, test three specimens of each type of masonry unit for each 5000 square feet of wall placed.
 5. The prisms shall be tested after 28 days but may be tested at seven days provided the relationship between seven and 28 day strengths has been established for the materials used prior to the start of construction.

6. When the average strength of a set of prisms falls below the specified compressive strength (f_m), the masonry corresponding to the test shall be deemed unacceptable. In such a case, notify the Architect and Contractor immediately.

3.6 STRUCTURAL STEEL

- A. Inspect all structural steel during and after erection for conformance with Contract Documents and shop drawings.
- B. Field Inspection
 1. Proper erection of all pieces.
 2. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
 3. Plumbness of structure and proper bracing.
 4. Field Painting.
 5. Visual examination of all field welding.
 6. Ultrasonic testing of all penetration welds.
 7. Installation of field welded shear studs.
 8. Measure and record camber of all beams upon arrival and before erection for compliance with the specified camber. Measure lying flat with web in horizontal position. Members outside specified camber tolerance shall be returned to the shop for remedial work.
- C. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed qualification tests within the last year using procedures specified in the AWS D1.1. Testing laboratory shall verify all welder's qualifications.
- D. Inspection of shop and field welding shall be "verification inspection," in accordance with Section 6 of AWS D1.1 and as follows:
 1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and check for seams, folds, and delamination.
 2. Ultrasonically test all penetration welds in accordance with AWS D1.1.
 3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted.
 4. The welding inspector shall be present during alignment and fit-up of members being welded and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in the root pass. Where weld has not penetrated completely, the inspector shall order the joint to be chipped down to sound metal or gouged out and rewelded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of crack.
 5. The inspector shall check that all welds have been marked with the welder's symbol. The inspector shall mark the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector.
 6. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other

- than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.
7. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
- E. Inspection of bolted construction shall be in accordance with AISC "Specification for Structural Steel Buildings" and as follows:
1. All bolts shall be visually inspected to ensure that the plies have been brought into snug contact.
 2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
 3. For all high strength bolts, unless specifically noted on the Drawings to require only "snug-tight" installation, the inspector shall observe the required jobsite testing and calibration and shall confirm that the procedure to be used provides the required tension.
 4. For slip critical connections, inspect the contact surfaces for compliance with specifications prior to bolting.
- F. Inspection of stud welding shall be in accordance with Section 7.8 of AWS D1.1 and as follows:
1. A minimum of two shear studs shall be welded at the start of each day's production period in order to determine proper generator, control unit and stud welding setting. These studs shall be capable of being bent at 45 degrees from vertical without weld failure.
 2. When the temperature is below 32 degrees Fahrenheit, one stud in each 100 shall be tested after cooling. Studs shall not be welded below zero degrees Fahrenheit or when the surface is wet due to rain, snow, or ice. If a stud fails, two new studs shall pass the test before resumption of the welding.
 3. Visually inspect studs for compliance with the Contract Documents. Check number, spacing, and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular. Studs failing this test shall be replaced.

3.7 OPEN WEB JOISTS AND JOIST GIRDERS

- A. Inspect all joists either in the plant or at the jobsite for conformance with specified fabrication requirements. Check welded connections between web and chord, splices, and straightness of members. Inspection at the plant may be performed by the manufacturer's qualified QC personnel.
- B. Inspect installation of joists at the jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance with the Contract Documents and referenced standards.
- C. Check welder qualification certificates for field welding operators.

3.8 STEEL FLOOR DECK

- A. Field Inspection shall consist of the following:

1. Check types, gauges, and finishes for conformance with the Contract Documents and shop drawings.
2. Examination of proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
3. Certification of welders.
4. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the structural steel section of this specification section.

3.9 STEEL ROOF DECK

A. Field inspection shall consist of the following:

1. Checking types, gauges, and finishes for conformance with the Contract Documents and Shop Drawings.
2. Examination for proper erection of all metal deck, including fastenings at supports and sidelaps, reinforcing of holes, and miscellaneous deck supports.
3. Certification of welders.
4. Visual inspection of at least 20 percent of all welds.

3.10 SPRAYED FIREPROOFING

- A. Verify that applied thickness, density, and bond strength of sprayed fireproofing meets fire rating requirements of approved design.
- B. Verify that installation meets fire rating requirements of approved design.
- C. Inspect and test for thickness as follows:
1. Test 20 percent of structural frame columns and beams in each building level.
 2. Test 10 percent of beams other than structural frame in each building level.
 3. Test one slab per each 5000 square feet of building area.
- D. Inspect and test for density on slabs, beams, and columns. Perform one of each test for each 10,000 square feet of building area.
- E. Inspect and test for bond strength, one test for beams and one test for slabs for each 10,000 square feet or area.
- F. Inspection and test procedures shall be performed in accordance with ASTM E605 and E736.

3.11 EXPANSION BOLT INSTALLATION

- A. Inspect the drilling of each hole and installation of each expansion bolt for compliance with the Contract Documents.
- B. Verify the installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.12 TESTING OF NON-SHRINK GROUT

- A. Make one strength test for every 15 base plates grouted and for every 15 bags of grout used in joints between members.
- B. Each test shall consist of four cubes, two to be tested at seven days, and two at 28 days, made and tested in accordance with ASTM C109, with the exception that the grout shall be restrained from expansion by a top plate.

3.13 EXCAVATION

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. Review geotechnical parameters and assumptions used in the development of calculations and drawings for retention systems, including lateral design forces, rock wedge stability analysis, rock bolt lengths and spacing, and surcharge effects.
- C. Observe the excavation process, the exposed faces of the excavation and the installation of retention systems. Check for compliance with the Contract Documents and make alternative recommendations as may be required to suit field conditions.
- D. Review required submittals as they pertain to geotechnical requirements.
- E. Check the adequacy and accuracy of the Contractor's monitoring program, equipment, procedures, and measurements related to movements of the excavated face and adjacent structures.
- F. Immediately report any observed unsafe conditions. Request additional shoring, bracing, or rock bolting where judged to be necessary as the excavation progresses.

3.14 WATER PRESSURE INJECTION OR LIME SLURRY PRESSURE INJECTION

- A. The representative of the Owner's Geotechnical Engineer shall make continuous observations throughout the injection operations as per the geotechnical report.
- B. The representative of the Owner's Geotechnical Engineer may propose to perform additional tests if required to properly evaluate the injected soil. The representative of the Owner's Geotechnical Engineer shall evaluate the results of the tests to determine the acceptability of the injected areas and to determine if additional injections are required.

3.15 FILLING AND BACKFILLING

- A. A representative of the Owner's Geotechnical Engineer shall provide the services specified in this section.
- B. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.
- C. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tests:

1. Test for liquid limit in accordance with ASTM D423.
 2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
 3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.
- D. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.
- E. Inspect under slab drainage material and placement for compliance with specified gradation, quality, and compaction.
- F. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:
1. One test for each 5000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
 2. One test for each 150 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
 3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

3.16 TILT-UP PANELS

- A. Concrete Reinforcing Steel and Embedded Metal Assemblies: Inspect in accordance with the Concrete Reinforcing Steel and Embedded Metal Assemblies section of this Specification.
- B. Concrete Inspection and Testing: Perform in accordance with the Concrete and Inspection and Testing section of this specification.
- C. Inspection of Tilt-up concrete during erection:
1. Inspect members for cracks, spalls, and other deficiencies after erection.
 2. Inspect erection of tilt-up members for placement tolerances, and to ensure that connections, bearing lengths, welding and grouting conform to the Contract Documents.

3.17 POST-TENSIONING

- A. Verify certification of calibration of jacking equipment used in post-tensioning operations.
- B. Observe and report on placement and anchorage of tendons immediately prior to concreting.
- C. Provide a qualified, experienced inspector to observe the stressing and elongation measurement of each tendon. Inspector shall have a minimum of five years' experience inspecting post-tensioning operations.
- D. The Contractor shall log and submit detailed reports of the stressing and elongation of each tendon. The laboratory representative shall observe the recording of information by the Contractor and make such spot checks as necessary to verify the accuracy of the post tensioning reports.

- E. Receive and review final stressing and elongation reports prepared by the contractor. Compare the actual and required elongation of each tendon and the actual and required load on each tendon. Grant permission to cut tails of tendons which are within the specified tolerance, unless otherwise noted on the Drawings, and submit reports of those which are not within the specified tolerance to the Architect for further evaluation.
- F. Observe and report on grouting of tendons noted to be bonded.
- G. Reports shall be submitted to the Architect within 48 hours after stressing.
- H. The post-tensioning subcontractor shall provide a letter at the completion of the project, signed and sealed by a registered engineer in the state of the project, stating that the post-tensioning work was completed in accordance with the contract documents. The post-tensioning subcontractor shall review the stressing records and certify that the required forces shown on the contract documents have been provided.

3.18 FOOTING EXCAVATIONS

- A. A representative of the Owner's Geotechnical Engineer shall inspect each footing excavation to determine that the proper bearing stratum is obtained and that excavations are properly clean and dry before the concrete is placed.

END OF SECTION 01 45 23

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements for temporary utilities, support facilities, and security and protection facilities, including but not limited to:
 - 1. Water service and distribution.
 - 2. Sanitary facilities, including toilets, wash facilities, and drinking water facilities.
 - 3. Heating and cooling facilities.
 - 4. Ventilation.
 - 5. Electric power service.
 - 6. Lighting.
 - 7. Telephone service.
 - 8. Waste disposal facilities.
 - 9. Field office.
 - 10. Storage and fabrication sheds.
 - 11. Lifts and hoists.
 - 12. Construction aids and miscellaneous services and facilities.
 - 13. Environmental protection.
 - 14. Pest control.
 - 15. Enclosure fence.
 - 16. Security enclosure and lockup.
 - 17. Barricades, warning signs, and lights.
 - 18. Temporary partitions.
 - 19. Fire protection.
 - 20. Accessories necessary for a complete installation.

1.3 USE CHARGES

- A. Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service: Pay sewer service use charges for water used and sewer usage by all entities for construction operations.
- C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Moisture Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 2. Indicate procedures for discarding water damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged work.
 3. Indicate sequencing of Work that requires water, such as sprayed fire resistive materials, plastering, and tile grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- C. Dust and HVAC Control Plan: Submit coordination drawing and narrative that indicates the dust and HVAC control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. HVAC system isolation schematic drawing.
 2. Location of proposed air-filtration system discharge.
 3. Waste handling procedures.
 4. Other dust control measures.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines (ADAAG), ICC/ANSI A117.1, and Texas Accessibility Standards (TAS) 2012.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Chain Link Fencing: Minimum 2 inch (50 mm), 0.148 inch (3.8 mm) thick, galvanized steel, chain link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8 inch (60 mm) OD line posts and 2-7/8 inch (73 mm) OD corner and pull posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils (0.25 mm) minimum thickness, with flame spread rating of 15 or less per ASTM E 84.
- D. Dust Control Adhesive Surface Walk off Mats: Provide mats minimum 36 inches by 60 inches (914 mm by 1624 mm).
- E. Insulation: Unfaced mineral fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame spread and smoke developed indexes of 25 and 50, respectively.

- F. Lumber and Plywood: Comply with requirements in Section 06 10 53.
- G. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; Type X or Type C panels with tapered edges. Comply with Section 09 29 00.
- H. Paint: Comply with requirements in Section 09 90 00.
- I. Tarpaulins: Fire resistive labeled with flame-spread rating of 15 or less.
- J. Water: Potable.

2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading. Provide elevated, stabilized concrete walkway from parking area to field offices.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, PM, Architect, and construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly.
 - 1. Provide elevated stabilized concrete walkway from parking area to field offices.
 - 2. Furnish and equip offices as follows:
 - a. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - b. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less 1 receptacle on each wall. Furnish room with conference table that will seat 10 attendees, chairs, and 4-foot-square track and marker boards.
 - c. Flex office for Architect's representative(s) and/or Owner representative including worktables with power and data.
 - d. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg. F.
 - e. Lighting fixtures capable of maintain average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. Air Filtration Units: HEPA primary and secondary filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.
- C. Drinking Water: Containerized, tap dispenser, bottled water drinking water units, including paper cup supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 degrees F to 55 degrees F (7.2 degrees C to 12.7 degrees C).
- D. Electrical Outlets: Properly configured, NEMA polarized outlets to prevent insertion of 110V to 120V plugs into higher voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- E. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

- F. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control.
 - 1. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction. Clean HVAC system as required in Section 01 77 00 and install new filter with MERV 11 or greater.
- G. Air Filtration Units: Primary and secondary HEPA filter equipped portable units with four stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. When establishing locations of Temporary Facilities, the owner shall have the opportunity to review and assist in final placement of trailers and traffic entry. The Contractor shall provide a layout of what is intended and gain approval before setting any fixed elements or traffic entries.
- B. The architect is to provide a construction site plan. The contractor may offer alternates to the layout but are subject to district approval. The following items are to be identified on the site plan:
 - 1. Entry/Exit
 - 2. Concrete Washout
 - 3. Dirt/mud/dust control at exit
 - 4. Job Trailer
 - 5. Temp power
 - 6. Temp water
 - 7. Dumpsters
 - 8. Conex storage
 - 9. Stored materials
 - 10. Contractor parking
- C. Trash cans 55 gallon shall be provided on site for worker debris and emptied every other day. A minimum of 3 cans shall be on the site at all times, not including at/near the job.
- D. Locate facilities where they will serve project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00.
- E. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. Install temporary service. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing Work, isolate the HVAC system in area where Work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in Work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within Work area using HEPA equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust producing equipment. Isolate limited Work within occupied areas using portable dust containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA filter equipped vacuum equipment.
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations. Install electric power service underground unless otherwise indicated.
1. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
 - a. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length voltage ratio.
 - b. Provide warning signs at power outlets other than 110 to 120 V.
 - c. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or traffic areas.
 - d. Provide metal conduit enclosures or boxes for wiring devices.
 - e. Provide 4 gang outlets, spaced so 100 foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.

- J. Telephone Service: Provide temporary telephone service in common use facilities for use by construction personnel. Install one telephone line(s) for each field office.
1. Provide dedicated telephone line for each facsimile machine in each field office.
 2. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- K. Electronic Communication Service: Provide a desktop computer and printer/scanner in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.
1. Provide high speed wireless internet access (provide access to the Owner and Architect); DSL or broadband. Dial-up connection is not acceptable.
 2. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall.
 3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 4. Backup: External hard drive, minimum 1 terabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 31 20 00.
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 4. Delay installation of final course of permanent pavement until immediately before Substantial Completion.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.

- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- F. Waste Disposal Facilities: Provide waste collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300.
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Temporary Elevator Use: Use of elevators is not permitted.
- I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SIGNS

- A. Furnish and install a project sign 6'-0" by 8'-0" (or 4'-0" x 8'-0" plywood. ASK PROJECT MANAGER) in size. Image will be provided to the graphics printing company by the Architect after Award of Contract. Contractor will be responsible for the cost of printing the image, mounting the sign on an aluminum substrate and installing the sign at the site. The sign will include the name of the project, District, name and title of Board of Trustees, District Superintendent, Contractor, Architect, and each of the project consultants.
- B. Other signs permitted at the site:
 - 1. Warning signs.
 - 2. Directional signs.
 - 3. Identification signs at field offices.
 - 4. Emergency medical services sign.
 - 5. Signs required by Authorities Having Jurisdiction
 - 6. Storm Water Pollution Prevention Plan sign (SWPPP)
- C. Contractor shall allow no other signs to be displayed at the project site, unless authorized by the Owner.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities to the satisfaction of Owner and Architect.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.
 2. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin. Provide site enclosure fence to prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each Work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor to ceiling dustproof partitions to limit dust and dirt migration and to separate occupied areas occupied from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire retardant treated plywood on construction operations side.
 2. Construct dustproof partitions with two layers of 6 mil (0.14 mm) polyethylene sheet on each side. Cover floor with two layers of 6 mil (0.14 mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire retardant treated plywood. Do not apply tape to finish floor surfaces.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water dampened foot mats in vestibule.

3. Where fire resistance rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 4. Insulate partitions to control noise transmission to occupied areas.
 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 6. Protect air handling equipment.
 7. Provide walk off mats at each entrance through temporary partition.
- M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire prevention and protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished Work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform Work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Condition Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits and moisture control.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum based products, which become wet during the course of construction and remain wet for 48 hours are considered defective and are to be removed and replaced.

- b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
- c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24 hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion unless otherwise required and approved by Owner and Architect.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00.

END OF SECTION 01 50 00

SECTION 01 56 39 - TREE PRUNING, FERTILIZING AND PROTECTION

PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS:** The Drawings, Division 0 and Division 1 apply to the Work in this Section.
- 1.2 DESCRIPTION OF THE WORK:**
- A. Work Included:
 - Protecting of existing trees (Refer also to the drawings).
 - Protecting of existing utilities.
 - Protection fencing and planking
- 1.3 GENERAL PROVISIONS:**
- A. Trees and areas scheduled for work under this contract shall be identified in the field and indicated on plans and specifications where practical. Where this is not practical, work shall be directed in field by Owner's Representative.
 - B. Provision for access to the site for heavy equipment will be as directed by Owner's Representative. Equipment shall use prescribed temporary roadways and shall not be allowed in areas other than designated construction areas and designated roadways. Open grass areas which are altered or disturbed by equipment during the work shall be returned to pre-existing conditions at no additional cost to Owner.
 - C. Contractor shall protect root areas and crowns of trees from damage from construction operations and construction equipment. The Contractor shall repair such damage at no costs to Owner. Provide fences or other barricade where necessary for such protection.
 - D. Contractor shall modify exhaust pipes on construction equipment as needed to ensure that tree crowns are not damaged from exhaust heat from vertical exhaust pipes on top of construction equipment.
 - E. Equipment shall not contact tree trunks, limbs or foliage.
 - F. Contractor shall be responsible for providing all tree work/repair to any damage to existing trees during the contract period. Damage to any existing trees shall be reported immediately to the Owner's Representative. Contractor shall submit to Owner's Representative a written program of corrective pruning and tree care to repair damage with name of qualified forester or arboriculturist for Owner's approval.
- 1.4 REFERENCE STANDARDS:**
American National Standard for Tree Care Operations Arisi-A-300 Tree shrub and other woody plant maintenance-standard practices, 1995.
- 1.5 SUBMITTALS:**
Furnish required copies of manufacturers literature, samples, certifications, or laboratory analytical data for the following items:
Tree paint (manufacturer's literature)
- A. Urban forester or Arborist. (Resume with education, experience, and credentials)
 - B. Soil separator (manufacturer's literature and sample). For vapor barrier 10 mil visquene
 - C. Gravel (one cubic foot)
 - D. Mulch: Decomposed hardwood mulch: submit 1 cubic foot sample.
 - E. Fertilizer: submit product data.

PART 2 – PRODUCTS

- 2.1 TRENCHING MACHINE:** Shall be small non-riding track type trencher equal to Case 300.
- 2.2 SHARP SAND:** ASTM C-33 for fine aggregate.
- 2.3 TREE PROTECTION FENCE POSTS:** 7' long metal t-posts.

- 2.4 TREE PAINT:** Thompson Tree Seal, Cabot Tree Paint or approved equal.
- 2.5 PRUNING TOOLS:** Shall be of good quality and working condition, sharp, and of the approved type for arboricultural work.
- 2.6 WOOD FOR TREE PROTECTION PLANKING:** Shall be construction grade Southern Yellow Pine.
A. Wood for planking: two (2") x four (4")
- 2.7 FENCING:** shall be orange plastic fencing 4' tall.
- 2.8 INSECTICIDE:** Shall be Ortho "Lindane Borer and Leaf Miner Spray" by Ortho Consumer Products Division, Chevron Chemical Company, San Francisco, California 94119 or approved equal.
- 2.9 FERTILIZER:** Arbor Green 30-10-7
- 2.10 WATER:** Suitable for irrigation.

PART 3 – EXECUTION

- 3.1 WORKMANSHIP:**
- A. Work shall be performed by personnel trained and experienced in this work and shall be done under the direction of a qualified forester or arborist on Contractor's staff. Owner shall review and approve Contractor's program for repair to damaged trees prior to the work being done.
- B. Work shall be performed in conformance with recognized horticultural and arboricultural practices. Where job requirements require deviation from normal practice, obtain approval.
- 3.2 LIMB PRUNING:** ANSI-A-300 1995
- 3.3 MAINTENANCE PRUNING:** Maintenance pruning is to maintain or improve tree health and structure and shall consist of the following: limited to branches measuring one (1") inch and larger.
- A. Crown cleaning: Crown cleaning shall consist of the removal of the following items: dead, dying, diseased, weak branches from a tree's crown. Remove waterspouts from trucks and major limbs clearing up to a maximum distance of only six (6) feet to eight (8) feet from main trunk.
- B. Crown thinning: Crown thinning shall consist of the selective removal of branches to increase light penetration, air movement, and reduce weight.
- C. Crown raising: Crown raising shall consist of the removal of the lower branches of a tree in order to provide clearance. Clearance to be determined by Owner's representative.
- D. All trees designated to remain and to be protected shall be pruned per ANSI-A-300 1995 standards.
1. All cuts shall be made as close as possible to the trunk or parent limb, without cutting into the branch collar or leaving a protruding stub. Bark at the edge of all pruning cuts should remain firmly attached.
 2. All branches too large to support with one hand shall be precut to avoid splitting or tearing of the bark. Where necessary, ropes or other equipment should be used to lower large branches or stubs into the ground.
 3. Trimming shall not alter the natural appearance or result in leaving a hole in the canopy.
 4. Paint wounds on Oak trees with approved paint.

5. Old injuries are to be inspected. Those not closing properly and where the callus growth is not already completely established should be bark traced if the bark appears loose or damaged. Such tracing shall not penetrate xylem (sapwood), and margins shall be kept rounded.
6. Equipment that will damage the bark and cambium layer should not be used on or in the tree. For example, the use of climbing spurs (hooks, irons) is not an acceptable work practice for pruning operations on live trees. Sharp tools shall be used so that clean cuts will be made at all times.
7. All cut limbs shall be removed from the crown upon completion of the pruning.
8. Trees susceptible to serious infectious diseases should not be pruned at the time of year during which the pathogens causing the diseases, or the insect vectors are most active. Similarly, if pruning wounds may attract harmful insects, pruning should be timed so as to avoid insect infestation.
9. Remove the weaker or less desirable of crossed or rubbing branches. Such removal, if possible, should not leave large open spaces in the general outline of the tree.
10. Where practical, all visible girdling roots shall be treated as follow: (1) Cut root at either end; or (2) Sever root in center with a chisel and allow growing tree to push root away; (3) Remove section of root.
11. The presence of any disease condition, fungus fruit bodies, decayed trunk or branches, split crotches or branches, cracks, or other structural weaknesses shall be reported in writing to a supervisor and/or the owner, and corrective measures recommended.

3.4 ROOT PRUNING: (in areas where roots cannot be preserved by hand digging)

- A. Root pruning shall be installed at the back of new curb for the parking lot excavation where the excavation for the lot lowers the grade below the existing grade within the drip line of the existing trees and in areas where soils will be lime stabilized.
- B. Root prune at edge of proposed excavation or lime stabilization only in areas where roots cannot be preserved.
- C. Root pruning by trenching shall be as required; twenty-four (24") inches deep and six (6") inches wide, or ten inches (10") below limits of proposed excavation, lime stabilization or soil disturbance, whichever is less.
- D. Trenching shall be performed by the approved trencher cutting any and all roots completely and cleanly. Tearing, shredding or pulling of the roots shall not be permitted. After trenching with machine, re-cut roots with pruning shears or saw to leave a smooth cut surface.
- E. Install 10 mil visquene in root prune trench to create non-leach barrier between soil stabilizer material and root zone.
- F. Fill trench to existing finished grade in a manner that will not allow soils to settle.
- G. Cover exposed roots within 24 hours using bank sand topsoil or mulch to prevent desiccation.

3.5 FENCES AND BARRICADES:

- A. Fences and/or barricades shall be installed prior to the commencement of any site preparation work (cleaning, grubbing or grading) placed where shown on the drawings or as herein described. Tree fencing shall be maintained throughout the construction project in order to prevent the following:
 1. Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment and/or equipment and/or materials.
 2. Root zone disturbances due to grade changes (greater than 3" inches cut or fill), and /or trenching not reviewed or authorized by the Owner's representative.
 3. Wounds to exposed roots, trunks, or limbs by mechanical equipment.
 4. Other activities detrimental to trees such as: chemical storage, cement truck wash-out and fires.

- B. In general, fences and barricades are intended to alert those working on the project that equipment and machinery are not to be stored or operated in the root zone. Where not shown, the fences shall be placed at the drip line. The exact location of fences shall be marked on site by Contractor and approved by Owner's Representative prior to construction of barricades.
- C. Posts shall be installed eight (8") feet O.C. maximum, one and one half (1 1/2') feet deep. Fence material pulled taut and secured with galvanized wire.

3.6 TREE PLANKING:

- A. Where exceptions result in temporary fence being closer than four feet to a tree trunk, protect trunk with strapped-on wood planking to a vertical height of 8 feet (or to the limits of the lower branches).
- B. Place two x fours with sides touching completely around the circumference of the tree. Secure at three points; top, middle and bottom with galvanized wire; twisted taut and stapled to wood planking.

3.7 TREE PROTECTION:

- A. All trees to be preserved on the property shall be protected against damage during construction operations by fencing as shown; subject to the approval of the Owner's Representative. The tree protection shall be installed prior to commencement of any site preparation work (clearing, grubbing or grading) and maintained in repair for the duration of the construction work unless otherwise directed. No material shall be stored or construction operation shall be carried on within a distance as shown of any tree to be saved or within the tree protection fencing. Tree protection shall remain until all work is completed.
 - 1. Place 6" of mulch to completely cover the area underneath the drip line of the trees in areas where foot traffic cannot be avoided.
 - 2. Trees shall be watered once a week during periods of hot dry weather as directed by Owner's representative to thoroughly saturate soil.
 - 3. All grading within protected root zone areas shall be by hand or small equipment to prevent root damage resulting from soil compaction and rutting. Prior to grading relocate protective fencing to two feet behind grade change area.
- B. Any damage done to existing tree crowns or root systems shall be repaired immediately by an approved tree surgeon at the Owner's direction. Roots exposed and/or damaged during demolition and/or grading operations shall be cut off cleanly inside the exposed or damaged area, the cut surfaces painted with an approved tree paint, and the topsoil and mulch placed over the exposed root area immediately. The Owner shall have his representative present on the site to observe these operations.

3.8 CONSTRUCTION EQUIPMENT:

- A. Contractor shall modify construction equipment as necessary to ensure that exhaust systems do not burn or scorch tree crowns or branches. Vertical exhaust pipes shall be turned 90 degrees.
- B. Height of equipment and equipment operation heights shall be carefully monitored to ensure no damage to tree crowns or branching.

3.9 BORER PROTECTION: Immediately after tree protection is complete, apply specified insecticide at the rate prescribed by the manufacturer's instructions.

3.10 APPLICATION OF TREE FERTILIZER: Arbor Green 30-10-7 mixed and applied per product label instruction for 40 pounds of Arbor Green mixed in 100 gallons of water. Fertilizer shall be added to tank and mixed on site. Owner's representative shall be notified 24 hours prior to applying fertilizer.

3.11 ADDITIONAL PROVISIONS:

- A. No trash or warming fires shall be placed within twenty five (25') feet of the tree canopy.

- B. No pedestrian traffic shall occur within the drip line of any tree without proper protection measures in place.
- C. No soil shall be spread, under any tree within the drip line, unless otherwise designated or approved by owner's representative.
- D. Hand dig to preserve roots measuring one inch (1") in diameter and larger, roots shall not be scuffed or damaged otherwise.

END OF SECTION 01 56 39

SECTION #01 56 39– TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Tree preservation work includes, but is not limited to:
 - 1. Protection of existing trees and all other indicated to remain in place.
 - 2. Maintenance of protected areas.
 - 3. Clearing and grubbing activity within protected areas.
 - 4. Damage compensation

1.3 APPLICABLE REGULATIONS

- A. Comply with all applicable local laws and regulations concerning tree preservation as well as the specific requirements stated elsewhere in the Specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING TREES TO REMAIN

- A. Tagging and Fencing
 - 1. Trees to remain shall be tagged and protective fencing installed prior to any construction, demolition, or other disturbance.
 - 2. Protective fencing shall be installed at the dripline of the tree to be protected unless otherwise noted on the Plans.
 - 3. The area inside the protective fencing will heretofore be referred to as the protected area.
 - 4. The Contractor shall verify tagged trees and fence locations in field with the Landscape Architect prior to any construction or demolition activity.

3.2 MAINTENANCE OF PROTECTED AREA

- A. No construction activity shall occur inside protected areas other than that landscape construction which is required for completion of the project.
 - 1. Construction activity includes, but is not limited to, building material storage, waste stockpiling, topsoil stockpiling, equipment storage or parking, disposal of waste materials of any kind, draining or flushing of tanks, canisters, drums, or other containers, trailer parking or storage, and demolition activity.
- B. No traffic, vehicular or pedestrian, shall encroach upon protected areas.
 - 1. This includes, but is not limited to, personal passenger vehicles, construction vehicles, grading machinery, and loading/lifting machinery.
- C. No material, machine, vehicle, or part thereof shall encroach above or below the vertical plane of the protective fencing into the protected area.
- D. The Contractor shall notify the Landscape Architect of any activity which might infringe or encroach upon the protected area prior to start of said activity.

3.3 ENCROACHMENT UPON PROTECTED AREA

- A. If encroachment into the protected area does occur, notify the Landscape Architect immediately.

3.4 ACTIVITY INSIDE PROTECTED AREAS END OF SECTION

- A. Clearing and Grubbing:

1. Clearing of small trees, shrubs, and herbaceous plants in the protected area shall be performed by hand only.
 2. Bulldozers and/or drag chain operations are not permissible inside protected areas.
 3. Grubbing of stumps shall be performed in two (2) ways:
 - a. under 6" diameter shall be pulled by chain.
 - 1) The vehicle used for pulling shall remain outside the protected area (dripline of the tree to remain) whenever possible.
 - 2) Under no circumstance shall the pulling vehicle encroach into the protected area by more than 1/3 of the distance from the trunk of tree to remain to the nearest edge of the protected area (dripline).
 - 3) Any depressions shall be filled with topsoil and leveled to grade by hand.
 - b. Stumps over 6" diameter shall be ground out to a depth of 4" below grade.
 - 1) Stump grinder shall be trailer mounted and maneuvered by light truck or bobcat.
 - 2) Wood chips generated by grinding shall be removed and any depressions shall be filled with topsoil and leveled to grade.
 - 3) These operations shall be performed by hand.
- B. Grading:
1. Any grading which may be required inside the protected area shall be performed by hand only.
 2. No grading or earthmoving machinery shall be allowed inside the protected area.
 3. Provide grade stakes and verify grade elevations with the Landscape Architect prior to commencement of any grading activity.
- C. Preparation of soil for seeding and/or sodding within the protected areas shall be done by hand or with a power rake and shall not disturb soil more than 2" deep to prevent damage to feeder root systems.
1. chemical herbicides shall be used within protected areas unless the Contractor can obtain written manufacturer's guarantee that herbicide will not harm tree health or growth and obtain written approval from the Landscape Architect.
 2. Contact the Landscape Architect prior to seed or sod preparation within protected areas to determine exact seed and/or sod limits.
- D. Stake locations of all utilities which encroach protected areas.
1. Contact the Landscape Architect prior to clearing or trenching for utilities to verify that staked location is the least obtrusive to protected area

3.5 REMOVAL OF PROTECTIVE FENCING

- A. Protective fencing may be removed to facilitate landscape work in the protected area.
1. All Work in the protected area shall be initiated within 24 hours of fence removal.
 2. If landscape work in the protected area is delayed or interrupted for more than 24 hours, then protective fencing shall be reinstalled until such time as work in the protected area is resumed.
 3. Protective fencing shall be reinstalled after substantial completion of work inside protected area and shall remain until substantial completion of the project or approval of the Landscape Architect, whichever is later.

3.6 DAMAGE COMPENSATION

- A. Any damage occurring to trees to remain or protected areas or removal of trees to remain in the protected areas caused by neglect, unauthorized encroachment and/or inadequate protection enforcement as
1. Financial Compensation for said damage or removal shall be determined by the Landscape Architect and Owner as per the following guidelines on a per occurrence basis

END OF SECTION #01 56 39

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for selection of products, including but not limited to:
 - 1. Product delivery, storage, and handling.
 - 2. Manufacturers' written warranties on products.
 - 3. Special warranties.
 - 4. Comparable products.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term *product* includes the terms *material*, *equipment*, *system*, *assembly*, and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis of Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words *basis of design product*, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the specified requirements.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00.

- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis of Design Product Specification Submittal: Comply with requirements in Section 01 33 00. Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long term storage at site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
 - 7. Provide a secure location and enclosure at site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

- B. Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 2. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and items needed for complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected", Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 3. Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 5. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and characteristics based on the product named. Comply with requirements for consideration of an unnamed product by one of the named manufacturers.
- C. Visual Matching Specification: Where Specifications require "*match Architect's sample*", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with specified requirements, comply with requirements of Section 01 25 00 for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "*selected by Architect*" or similar phrase, select a product that complies with requirements. Architect will select color,

gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair Work required to restore construction to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Certificates: Submit certificate signed by **land surveyor or professional engineer** certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor legally qualified to practice in the State of Texas, who is experienced in providing land surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.

- B. In Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not warranted. Before beginning site Work, investigate and verify existence and location of underground utilities, mechanical and electrical systems, and construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water service piping; underground electrical services, and other utilities.
 - 2. Furnish location data for Work related to the Work that must be performed by public utilities serving the site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation after correcting unsatisfactory conditions. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as necessary to locate each element of Project.
 - 2. Establish limits on use of site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical Work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control Work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other Work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions ensuring the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous. Materials containing asbestos and BCPs are prohibited.

3.6 OWNER INSTALLED PRODUCTS

- A. Site Access: Provide access to site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with Work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's Work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. Clean site and Work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F (27 degrees C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 50 00.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with mechanical, plumbing, and electrical requirements.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 73 29 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Procedural requirements for cutting and patching.

1.3 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair Work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products used for patching and firms or entities that will perform patching Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
- B. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
- C. Operational Elements: Do not cut and patch operating elements and related components that results in reducing the capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Fire separation assemblies.
 - 3. Air or smoke barriers.
 - 4. Fire suppression systems.
 - 5. Mechanical systems piping and ducts.

6. Control systems.
 7. Communication systems.
 8. Fire-detection and -alarm systems.
 9. Conveying systems.
 10. Electrical wiring systems.
 11. Operating systems of special construction.
- D. Miscellaneous Elements: Do not cut and patch the following elements or related components that change the load bearing capacity, resulting in a reduction of capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
 2. Membranes and flashings.
 3. Exterior curtain wall construction.
 4. Equipment supports.
 5. Piping, ductwork, vessels, and equipment.
 6. Noise and vibration control elements and systems.
 7. Sprayed fire resistive material.
- E. Visual Requirements: Do not cut and patch construction resulting in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work. If possible, engage original Installer or fabricator. If original installer is not available, engage recognized, experienced, and specialized firm for the Work.
 - a. Processed concrete finishes.
 - b. Ornamental metal.
 - c. Matched veneer woodwork.
 - d. Preformed metal panels.
 - e. Roofing.
 - f. Firestopping.
 - g. Window system.
 - h. Fluid applied flooring.
 - i. Wall covering.
 - j. HVAC enclosures, cabinets, or covers.
- F. Cutting and Patching Conference: Before proceeding, meet at site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with specified requirements.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where removal, relocation, or abandonment is necessary, bypass existing services before cutting to avoid interruption of services to occupied areas.

3.3 CUTTING AND PATCHING

- A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of components or performance of construction, and subsequently patch as necessary to restore surfaces to an original condition.
 - 2. Cut in place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of Work to be cut.
- C. Protection: Protect in place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00.
- E. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. Use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable earthwork specifications by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction to eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions are removed, extend one finished area into another, patch and repair surfaces in new space. Provide even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
 4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 5. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
 6. Exterior Building Enclosure: Patch components and restore enclosure to a weathertight condition.

END OF SECTION 01 73 29

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 PRE-CLOSEOUT MEETING

- A. Pre-Closeout Meeting: Schedule and convene Pre-Closeout Meeting with Owner and Architect in accordance with Section 01 31 00, Project Coordination and Management.

1.3 SUBSTANTIAL COMPLETION

- A. The items listed in the Supplementary Conditions, Paragraph 9.8 and the following items shall be completed before Substantial Completion will be issued:
 - 1. Contractor's (Punch List): Submit a thorough list of items to be completed or corrected, along with a written request for Substantial Completion and for review of the Work. The Architect/Engineer's Project Representative, at their discretion, may attend and assist in the preparation of the Contractor's Punch List.
 - 2. Architect's Supplemental Punch List: The Architect/Engineer, along with the Owner at the Owner's discretion, will inspect the Work utilizing the Contractor's prepared Punch List, noting completed items and incomplete items, and will prepare a supplemental list of items that have been omitted or incomplete items that were not previously noted.
 - 3. Operations and Maintenance Manuals: Submit as described in paragraph 1.3.
 - 4. Final Cleaning: Provide final cleaning and adequate protection of installed construction as described in paragraph 1.8.
 - 5. Starting of systems: Start up equipment and systems as described in paragraph 1.8.
 - 6. Testing and balancing: Testing and balancing of systems must be performed and completed and the report submitted and accepted by Architect/Engineer and Owner, as described in the Contract Documents. Make adjustments to equipment as required to achieve acceptance.
 - 7. Demonstrations: If required by individual specification sections or by Owner, provide demonstrations and instructions for use of equipment as described in paragraph 1.9.
- B. Date of Substantial Completion: Complete or correct items identified on Punch List and confirm that all items have been corrected prior to Architects re-inspection. Architect/Engineer, along with the Owner, will re-inspect the corrected work to establish the Date of Substantial Completion. Incomplete items remaining will be appended to the Certificate of Substantial Completion (AIA G704). The Date of Substantial Completion represents day one (1) of the closeout period, and represents the date of commencement of the Contractors correctional period and all warranty periods as described and required by the Contract Documents, except as amended in the Certificate of Substantial Completion and elsewhere in the Contract Documents.
- C. Certificate of Substantial Completion: When the Work or designated portion thereof is substantially complete, Architect will prepare the Certificate of Substantial Completion to be executed by the Owner and Contractor. Items on the appended Punch List shall be completed or corrected within the time limits established in the Certificate.
- D. Within thirty (30) calendar days of substantial completion, contractor shall submit closeout submittals as required in accordance with this section.

1.4 PUNCH LIST

- A. A comprehensive list prepared by the Contractor 3 weeks prior to Substantial Completion, and attached thereto, to establish all items to be corrected, or limited items of Work to be completed, if any. This list is intended to represent a limited number of items needing attention.
- B. Punch lists shall be furnished to the Architect in Microsoft Excel and PDF formats. The punch list shall be in matrix form and shall include the following information for each punch list item:
 - 1. Room number or other suitable location identifier
 - 2. Description of the work
 - 3. Sub-contractor/trade sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 - 4. Sub-contractor/trade sign-off date
 - 5. General contractor sign-off that the work has been verified to be 100% complete and in accordance with the Contract Documents
 - 6. General contractor/trade sign-off date
 - 7. A/E consultant sign-off
 - 8. A/E consultant sign-off date
 - 9. If requested by the Owner, provide two additional similar columns for their sign-off.
 - 10. In the case of excessive repetition of the same item at various locations, the punch list may contain "general notes/items" that shall be applied to the entire project; and it shall be the responsibility of the contractor/sub-contractor to thoroughly examine the entire project and make corrective measures at all applicable locations.
- C. Should the Architect determine that the Contractor's punch list lacks sufficient detail or requires extensive supplementation, the punch list will be returned to the Contractor for re-inspection and revision. The date of Substantial Completion will be delayed until the punch list submitted is a reasonable representation of the work to be done.
- D. A significantly large number of items to be completed or corrected will preclude the Architect from issuing a Certificate of Substantial Completion. The Owner and Architect will be the sole judge of what constitutes a significantly large number of items.
- E. The Contractor's superintendent shall participate in the preparation of the Contractor's punch list that is submitted to the Architect and Owner for supplementation. Upon receipt, the Architect and Consultants shall perform a spot review to determine the adequacy and completeness of the Contractor's punch list.
- F. The Owner shall be notified 48 hours prior to the Architect/Contractor starting the Punch List walk. The Owner will participate, and their comments shall be incorporated. Where there is a conflict of opinion, the item shall still be recorded, and the Program Manager will work to a resolution.
- G. The Architects Punchlist shall be distributed to the Contractor and Owner within 5 business days of the final day of walking
- H. Upon receipt of an acceptable Contractor's punch list, the Contractor's Superintendent shall accompany the Architect, his Consultants and the Owner (at his discretion) during their observation and the preparation of their supplements to the Contractor's punch list.
 - 1. The Superintendent shall record or otherwise take note of all supplementary items.
 - 2. The Architect will endeavor to furnish to the Contractor typed, hand written or recorded supplements to the punch list in a prompt manner; however, any delay in the

Contractor's receiving said supplements from the Architect will not be cause for a claim for additional cost or extension of time as the Contractor's Superintendent shall have been in attendance during the inspections of the Architect and his Consultants and will have been expected to take his own notes.

1.5 OPERATIONS AND MAINTENANCE MANUAL

- A. As a requirement for Substantial Completion, the final Operation and Maintenance Manual shall be submitted to, and reviewed and accepted by the Architect prior to issuance of the Certificate.
- B. Submit one (1) copy of preliminary Operations and Maintenance Manuals to respective consultants (Civil, MEP, Structural, etc.) for review of conformance with contract requirements prior to submitting final to Architect. Allow time for proper review.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and Maintenance, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Equipment start-up instructions
 - e. Operating instructions.
 - f. Maintenance instructions for equipment and systems.
 - g. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Product data.
 - b. Air and water balance reports.
 - c. Photocopies of warranties, certificates and bonds. Submit originals with Closeout Documents as specified below.
- F. Contractor shall provide a flash drive, in PDF Format, the following documents after approval by the Architect, Consultants and Owner: closeout manual, MSDS binder, O&M Manuals, specifications and approved submittals. Documents shall be hyper-linked to the Table of Contents.

1.6 PROJECT CLOSEOUT PROCEDURES

- A. Final Payment will not be authorized by the Architect until the Architect finds the Work acceptable under the Contract Documents, subject to the completion and acceptance of the following requirements and other applicable Contract requirements:
 - 1. Close-out Documents: Provide bound closeout documents as described in paragraph 1.5. Refer to the Supplementary Conditions, Paragraph 9.10 for additional information.
 - 2. Record Documents: Submit as described in paragraph 1.10.

3. Extra materials: Provide extra stock, materials, and products as described in paragraph 1.11 when required by individual specification sections.
4. Locks: Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
5. Temporary Facilities: Discontinue and remove temporary facilities from the site, along with mockups, construction aids, and similar elements.
6. Warranties, Certificates and Bonds: Execute and assemble transferable warranty documents, certificates, and bonds from subcontractors, suppliers, and manufacturers as described in paragraph 1.12.
7. Final Inspection and Acceptance by Architect is achieved as described in paragraph 1.13.

1.7 CLOSEOUT DOCUMENTS

- A. Coordinate the following items with the requirements of Supplementary Conditions of the Contract.
- B. Create a Single Flash Drive with a Bookmarked PDF in this order (OMIT Anything Not Applicable)
 - Project Directory
 - Final List of Final Subcontractor/Supplier (AIA G805)
 - Contractor's Affidavit of Payment & Debts Claim (AIA G706)
 - Contractor's Affidavit of Release of Liens (AIA G706A)
 - Certificate of Substantial Completion (AIA G704)
 - Consent of Surety of Final Payment (AIA G707)
 - Subcontractor/Supplier Release of Final Payment
 - General Contractor Warranty
 - Subcontractor's One Year Warranties
 - List of Extended Warranties by Division
 - Subcontractor's Extended Warranties
 - General Contractor Hazardous Material Free (Asbestos/PCB/Lead) Certificate
 - Subcontractor/Supplier Hazardous Materials Free (Asbestos/PCB/Lead) Certificate
 - Architect Hazardous Materials Free (Asbestos/PCB/Lead) Letter
 - Mechanical Subcontractor/Supplier Refrigerant Certificate
 - Materials Testing Letter of Compliance
 - Certificate of TEA Compliance
 - Building Envelope Letter of Compliance
 - Extra Stock and Demonstrations
 - ~~○ Elevator Inspection & Acceptance~~
 - ~~○ Windstorm Certificate~~
 - ~~○ TCEQ Clearance Letter~~
 - ~~○ MEP Com Check Inspection~~
 - ~~○ Plumber Valve Tag Index~~
 - Fire alarm Certificate
 - ~~○ Stage Curtain Certificate~~
 - ~~○ TAS Review & Acceptance~~
 - ~~○ Kitchen Permit~~
 - ~~○ Boiler Permit~~
 - ~~○ Backflow Tests / Inspections~~

- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. The close-out documents shall be neatly organized and easily useable as determined by the Architect and Owner. Separate Close-out Documents binders from Operations and Maintenance Manuals. Documents identified as "affidavit" shall be notarized.
- E. Contents: Prepare Table of Contents for each volume, with each item description identified, typed on white paper to ensure completeness.
- F. Failure to complete and close-out project after substantial completion may result in liquidated damages being assessed to the Contractor. Refer to Conditions of the Contract for additional requirements and liquidated damages.

1.8 FINAL CLEANING

- A. Execute final cleaning prior to final project inspection and acceptance.
- B. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces, mop hard floor surfaces.
- B. Remove smudges, marks, stains, fingerprints, soil, dirt, spots, dust, lint, and other foreign materials from finished and exposed surfaces
- C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- D. Clean and replace filters of operating equipment as required by Contract Documents
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and temporary construction facilities from site.

1.9 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections until Work is accepted by Architect and Owner.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.10 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer and Owner 48 hours prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of Contractors' personnel, and installer in accordance with manufacturers' instructions.
- G. When specified in individual specification sections or required by manufacturer, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. When specified in individual specification sections or required by Owner or Architect/Engineer, submit a written report in accordance with Section 01 33 00, Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

1.11 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel a minimum of 48 hours prior to date of Final Completion in accordance with Owner's requirements.
- B. Demonstrate Project equipment instructed by qualified manufacturer's representative who is knowledgeable about the Project and equipment.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
- D. Utilize maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment.
- F. Prepare and insert additional data in maintenance manuals when need for additional data becomes apparent during instruction.
- G. Review and verify proper start-up and operation of equipment prior to scheduling demonstrations with Owner.
- H. All demonstrations are to be documented by video and submitted to the Owner in DVD format along with the close out documents. General contractor is responsible for all video and compilation onto DVD with linked menus.

1.12 PROJECT RECORD DOCUMENTS

- A. Project Record Documents, as described in Section 01 78 39, shall be submitted at Project Closeout. Final Payment will not be authorized by the Architect until final review and acceptance by Architect and Engineers is achieved in accordance with the Owners requirements.
- B. Submit reproducible to respective consultants (Civil, Structural, MEP, *etc.*) for review. Consultant will mark-up corrections and return to Contractor for final revisions. Make final revisions prior to submitting to Architect.
 - 1. Format: One (1) set of film positive reproducibles and two (2) sets blueines of approved reproducibles.
 - 2. Provide the Owner with one (1) set of Record Drawings on a non-rewritable CD in AutoCAD® latest release or BIM files per Owner's request.
 - 3. Provide the Owner with one (1) set of Record Drawings on a on a non-rewritable CD in PDF format.
 - 4. Label electronic BIM files and PDF files in the same manner as the sheets (example, A2.02 First Floor Area 'A', *etc.*)
 - 5. Format: Submit all Project Record Documents as a bookmarked, indexed, searchable, annotated electronic PDF file.

1.13 EXTRA STOCK, MATERIALS AND MAINTENANCE PRODUCTS

- A. Furnish extra stock, maintenance, and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site or to District Maintenance Department as directed by Owner; obtain signed receipt from Owner's authorized representative prior to final application for payment. Delivery of materials to, or obtaining receipt from anyone other than Owner's authorized representative may constitute breach of this requirement and may require delivery of additional materials at no cost to the Owner if original materials are misplaced.
- C. Include signed receipts for delivery of extra stock and materials, including keys, with Closeout Documents.
- D. Attic Stock and Extra Materials
 - a. All stored materials or attic stock shall be delivered to the District. The location will be coordinated with the district. Materials shall be boxed and labeled. Prior to any delivery the contractor must contact the pre-determined person and arrange a time to drop off materials.
 - b. Provide 48-hour notice prior to delivery.
 - c. Deliveries shall include and itemized list of materials or attic stock. A transmittal stating attic stock is not acceptable. A copy of this list is considered part of the delivery and acceptance without this list will not be made.
 - d. One set of all filters per location for all Mechanical Units minimum.
 - e. For Water Softener – provide 400 pounds of salt in addition to the full system at turn over.
 - f. Rebuild Kit for all backflow preventers. (1) kit per type.
 - g. All other filters – A/E shall verify these have been changed during the punch list walk post Substantial Completion.
 - h. All filters shall be changed no sooner than 1 week prior to the Substantial Completion or they will have to be changed again.
 - i. Keys – Building keys- Refer to Keying but no keys are to be provided to any staff. All key transfers shall be to the Chief of Operations Officer in person. Any key that is provided to staff other than the Chief Operations Officer will be considered free and not a part of the official count.

Attic Stock Checklist

The following is a standard list of added stock to be included in the specifications of each project (as applicable).

DIVISION	SECTION	REQUIRED ADDED STOCK	DELIVERY LOCATION
03	Concrete	None	N/A
04	Masonry	None	N/A
05	Metals	None	N/A
06	Wood, Plastics & Composites	None	N/A
08	Doors – Wood	2 full sheets (4' x 8') of each color of plastic laminate 2 full sheets of door laminate (equal to largest door)	HISD Maintenance
08	Doors - Hardware	3 keys each set 500 key blanks 1 key cabinet for 150% capacity 2 tag filing systems for 125% of all locks furnished	On Site
09	Ceramic Tile	1 box of each size and color of each type (floor and wall)	HISD Maintenance
09	Quarry Tile	1 box of each size and color of same production run including base	HISD Maintenance
09	Porcelain Tile	4 boxes of each color tile and base from same production run	HISD Maintenance
09	Acoustic Ceiling	3 cartons of ceiling material 1 box of suspension system material	HISD Maintenance
09	Wood Gymnasium Flooring	2% of installed material quantity	HISD Maintenance
09	VCT/LVT/MCT	Greater of 4% or one carton of each color and pattern of installed material quantity One gallon of each type of adhesive used	HISD Maintenance
09	Epoxy Flooring	1 gallon of Primer, Receiver Coat and Top Coat. 1 carton of flake of each pattern used	HISD Maintenance
09	Resilient Wall Base	Greater of 4% or one carton of each color and pattern of installed material quantity One gallon of each type of adhesive used	HISD Maintenance
09	Carpet	5% of each installed material quantity	HISD Maintenance
09	Painting	10 gallons of each color, type and gloss	HISD Maintenance
10	Clinic Curtains & Track	5% of installed amount of carriers and track and caps	HISD Maintenance
21	Fire Protection System	4 additional of each type of fire extinguisher	HISD Maintenance

1.14 WARRANTIES, CERTIFICATES AND BONDS

A. Definitions:

1. Standard Product Warranties: preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
 2. Special Warranties: written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide coverage of specific defects, or both.
- B. In accordance with the general warranty obligations under Paragraph 3.5 of the General Conditions as amended by the Supplementary Conditions, the General Contractor's warranty shall be for a period of one (1) year following the date of Substantial Completion, hereinafter called the one-year warranty period. The Contractor's one-year general warranty shall include all labor, material and delivery costs required to correct defective material and installation. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.
- C. The Contractor's one-year warranty shall run concurrently with the one (1) year period for correction of Work required under Paragraph 12.2 of the General Conditions.
- D. No service charges or call out charges are allowed to investigate warranty claims.
- E. In addition to the Contractor's one-year warranty, Special Warranties as described in individual specifications sections, shall extend the warranty period for the period specified without limitation in respect to other obligations which the Contractor has under the Contract Documents.
- F. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve the suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- G. Warranty Requirements:
1. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
 2. When Work covered by a warranty has failed and been corrected by replacement or reconstruction, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
 3. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 4. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 5. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or designated portion of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- H. Compile copies of each required warranty properly executed by the Contractor and the subcontractor, supplier, or manufacturer. Verify documents are in proper form, contain full information, and are notarized. Co-execute warranties, certificates and bonds when required and include signed warranties with Closeout Documents submitted to the Architect.

1.15 FINAL COMPLETION AND FINAL PAYMENT

- A. Final Notice and Inspection:

1. When all items on the Punch List have been corrected, final cleaning has been completed, and installed work has been protected, submit written notice to the Architect that the Work is ready for final inspection and acceptance.
 2. Upon receipt of written notice that the Work is ready for final inspection and acceptance, the Architect and Engineer will make final inspection.
- B. Final Change Order: When the Project Closeout items described above are successfully completed and the Work is found acceptable to Architect/Engineer and Owner, a Final Change Order will be executed. This Change Order will include any Allowance adjustments as required by the Contract Documents.
- C. Final Application for Payment: When all of the above items are successfully complete, submit to the Architect a final Application for Payment and request for release of retainage.
- D. Release of Retainage: Release of retainage will not be authorized by the Architect until Contractor completes all requirements for close-out to the satisfaction of the Owner and Architect as described herein.

1.16 TERMINAL INSPECTION

- A. Immediately prior to expiration of the one (1) year period for correction of the Work, the Contractor shall make an inspection of the work in the company of the Architect and the Owner. The Architect and the Owner shall be given not less than ten (10) days notice prior to the anticipated date of terminal inspection.
- B. Where any portion of the work has proven to be defective and requires replacement, repair or adjustment, the Contractor shall immediately provide materials and labor necessary to remedy such defective work and shall execute such work without delay until completed to the satisfaction of the Architect and the Owner, even if the date of completion of the corrective work may extend beyond the expiration date of the correction period.
- C. The Contractor shall not be responsible for correction of work which has been damaged because of neglect or abuse by the Owner nor the replacement of parts necessitated by normal wear in use.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

PART 4 – SCHEDULE

Item	Date of Issue
Schedule of Closeout Conference	180 days before Substantial Completion
Operations & Maintenance Manuals	60 Days before Substantial Completion
Contractor's Punch List	Include with formal request for Substantial Completion.
As-Builts	30 Days after Substantial Completion
Affidavits	30 Days after Substantial Completion
Release of Liens	60 Days after Substantial Completion
Testing and Balance Report	60 Days after Substantial Completion
Warranty Forms	60 Days after Substantial Completion

PBK Architects
Project No. 240157

New CTE Center & Hargrave High School Additions & Renovations
Huffman Independent School District

END OF SECTION 01 77 00

SECTION 01 77 00 CLOSEOUT FORMS

CLOSE-OUT FORM "A"

SUBCONTRACTOR'S AFFIDAVIT OF RELEASE OF LIEN

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the _____ of _____, the subcontractor who supplied, installed, and /or erected the work described below, and that, he /she is duly authorized to make this Affidavit and Subcontractor Release:

Project: New CTE Center & Hargrave High School Additions & Renovations

Owner: Huffman ISD

Architect: PBK

Work Performed: _____ Specification Section(s): _____

2. That all work required under the subject subcontractor of the subject construction project has been performed in accordance with the terms thereof, that all material men, sub-subcontractors, mechanics, and laborers have been paid and satisfied in full and that there are no outstanding claims of any character arising out of the performance of said subcontractor which have not been paid and satisfied in full.
3. That to the best of his / her knowledge and belief, there are no unsatisfied claims for damages resulting from injury or death to any employees, sub-subcontractors, or the public at large arising out of the performance of said subcontract, or any suits or claims for any other damages of any kind, nature, or description which might constitute a lien upon the property of the Owner.
4. That he / she has received full payment of all sums due him / her for materials furnished and services rendered by the undersigned in connection with the performance of said subcontract and has and does hereby release the Owner and the Architect and his consultants and the Contractor from any and all claims of any character arising out of or in any way connected with performance of said subcontract.

ATTEST (If Corporation)

Name of Subcontractor

Secretary

(By)

(Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

(Seal)

(Notary Public Signature)

CLOSE OUT FORM "B"

**CERTIFICATION
OF PROJECT
COMPLIANCE**

Completion of this form is required under the provisions of §61.1040 19 TAC for all public school district construction projects. Instructions for completion of this form can be found on page 2.

1. PROJECT INFORMATION

Facility:

Address:

City:

DISTRICT:

ARCHITECT/ENGINEER:

CONTRACTOR/CM:

CONTRACT DATE:

DATE DISTRICT AUTHORIZED PROJECT:

BRIEF DESCRIPTION OF PROJECT:

2. CERTIFICATION OF DESIGN AND CONSTRUCTION

The intent of this document is to assure that the school district has provided to the architect/engineer the required information and the architect/engineer has reviewed the School Facilities Standards as required by the State of Texas, and used his/her reasonable professional judgment and care in the architectural/engineering design and that the contractor has constructed the project in a quality manner in general conformance with the design requirements and that the school district certifies to project completion.

3. The District certifies the following:

- 1.) The educational specifications of this facility presented to the school board of trustees were provided to the prime design professional in a timely manner.
- 2.) The long range facility plan was developed presented to the school board and provided in a timely manner to the prime design professional in a timely manner.
- 3.) That a design professional was hired to achieve the goals and expectations of the long range facility plan, and if applicable educational specifications.
- 4.) The safety and security standards were provided as a directive in a timely manner to the architect.

DISTRICT:

BY:

DATE:

4. The Architect/Engineer certifies the above information was received from the school district, and that the building(s) were designed in accordance with the applicable building codes. Further, the project has been designed in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of Education, November 1, 2021, and as provided by the district. This includes the compliance path directives of section (g) or (h) and the safety and security directives in section (k) found in the above standard.

ARCHITECT/ENGINEER:

BY:

DATE:

5. The Contractor/CM the project has been built in reasonable accordance with the long range facility plan and educational specifications based on the School Facilities Standards as adopted by the Commissioner of Education, November 1, 2021, and as provided by the district. This includes the safety and security directives in section (k) found in the above standard. In addition, certifies that the building has been found to not have any violations by the local authority of jurisdiction or third party code inspector.

CONTRACTOR/CM:

BY:

DATE:

6. The District certifies completion of the project (as defined by the architect/engineer and contractor).

DISTRICT:

BY:

DATE:

INSTRUCTIONS FOR COMPLETION OF "CERTIFICATION OF PROJECT COMPLIANCE" FORM

Section 1. Identify the following:

- name and address of the school facility
- name of the school district
- the Architect/Engineer and Contractor
- the date of execution of the construction contract
- the date that the school district authorized the superintendent to hire an architect/engineer
- scope of the project.

Section 2. This section outlines the intent of the document. No action required.

Section 3. This section is to be executed by the school district upon transmittal of the information (as listed) to the architect/engineer and is to remain in the custody of the school district throughout the entire project.

Section 4. This section is to be executed by the architect/engineer upon completion of the plans and specifications and in conjunction with the completion of the plan review for code compliance (ref. 19 TAC §61.1040, School Facilities Standards) and returned to the school district's files.

Section 5. This section is to be executed by the contractor upon substantial completion of the project and retained in the school district's files.

Section 6. This section is to be executed by the school district upon acceptance and occupancy of the project.

NOTE: DO NOT SUBMIT THIS DOCUMENT TO THE TEXAS EDUCATION AGENCY. The school district will retain this document in their files indefinitely until review and/or submittal is required by representatives of the Texas Education Agency.

CLOSE-OUT FORM "C"

SUBCONTRACTOR HAZARDOUS MATERIAL CERTIFICATE

THE STATE OF _____ PROJECT: New CTE Center & Hargrave High School
Additions & Renovations
COUNTY OF _____ OWNER: Huffman ISD
ARCHITECT: PBK
SPECIFICATION SECTION(S):

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says that he / she
is the _____ of _____, the subcontractor / supplier
who constructed or provided the section(s) of work referenced above, and that he / she is duly authorized
to certify to the best of his / her information, knowledge, and belief no asbestos, lead or PCB containing
products have been incorporated into the project.

ATTEST (If Corporation)

Name of Subcontractor / Supplier

(Title) Secretary (By)

JURAT

THE STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20_____.

(Seal)

(Notary Public Signature)

CLOSE-OUT FORM "D"

SUBCONTRACTOR WARRANTY

STATE OF _____

COUNTY OF _____

KNOW ALL MEN BY THESE PRESENTS:

_____, being first duly sworn, deposes and says:

1. That he / she is the Subcontractor (or the _____ of _____ the subcontractor) who supplied, installed, and / or erected the work described below, and that, he / she is duly authorized to make this Subcontractor Warranty:

Project: New CTE Center & Hargrave High School Additions & Renovations

Owner: Huffman ISD

Architect: PBK

Work Performed: _____ Specification Section(s): _____

2. The undersigned Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract are of good quality and new except where otherwise required or permitted by the Contract Documents, that the Work is free from defects not inherent in the quality required or permitted, and that the Work conforms with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.
3. In the event of failure of materials, products, or workmanship, during the specified warranty periods, the Subcontractor shall take appropriate measures to assure correction or replacement of the defective items, whether notified by the Contractor, Owner or Architect.
4. The Subcontractor warrants the work performed for a period of _____ months from the date of Substantial Completion, except as follows: _____

ATTEST (If Corporation)

Name of Subcontractor

Secretary

(By)

(Title)

JURAT

STATE OF _____

COUNTY OF _____

Sworn to and subscribed before me on this _____ day of _____, 20____.

(Seal)

(Notary Public Signature)

SECTION 01 77 02 - WAIVER AND RELEASE OF LIENS

PART 1 GENERAL

1.1 SUMMARY

- A. Document Includes: Applicability and use of statutory Waiver and Release of Lien forms promulgated by the Legislature of the State of Texas for construction projects in Texas.
- B. Related Requirements:
 - 1. The Contract for Construction (also referred to as the Agreement or the Contract)
 - 2. Conditions of the Contract (General, Supplementary, and other conditions, if any)
 - 3. Section 01 29 00 Payment Procedures
 - 4. Section 01 77 00 Contract Closeout
 - 5. Section 01 77 01 Closeout Procedures

1.2 REFERENCES

- A. Texas Property Code, Chapter 53, Subchapter L, Sections 53.281 thru 53.287 (includes the standard forms attached herewith immediately following this section):
 - 1. Form 1: Conditional Waiver for Progress Payments
 - 2. Form 2: Unconditional Waiver for Progress Payments
 - 3. Form 3: Conditional Waiver for Final Payments
 - 4. Form 4: Unconditional Waiver for Final Payments

PART 2 PRODUCTS *(not used)*

PART 3 EXECUTION

3.1 SELECTION AND USE OF WAIVER AND RELEASE OF LIEN FORMS

- A. Based on answers to the following questions, use the applicable form for the occasion:
 - 1. Is the payment a *progress* payment (partial, not final), or a *final* payment?
 - 2. Is the release *unconditional* (for a payment already received), or *conditional* (given in anticipation of a payment not yet received)?
- B. Submit the applicable form, properly executed (filled out, signed and dated) and notarized, on each occasion required (see other portions of the Contract Documents, including but not necessarily limited to the related requirements documents cited above).
- C. The wording of these forms is prescribed by the State of Texas. Questions regarding their use, execution, etc. should be directed to user's own attorney experienced in construction or lien law. This document is not to be interpreted as rendering legal advice.
- D. Even if the Contract Documents do not explicitly require submittal of Waivers and Releases of Liens for every payment (for example, omitting them for monthly progress payments), the Owner reserves the right, at its sole discretion, to require applicable Waivers and Releases of Liens, executed and notarized, for any or all payments.

END OF SECTION 01 77 02
(see following pages for standard forms)

FORM 1: CONDITIONAL WAIVER FOR PROGRESS PAYMENTS

PROJECT NAME: _____
OWNER'S NAME: _____ PROJECT NUMBER _____

CONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

On receipt by the signer of this document of a check from _____ (maker of check) in the sum of \$_____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of _____ (owner) located at _____ (location) to the following extent:
_____ (job description).

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date _____
_____ (Company name)
By _____ (Signature)
_____ (Printed/Typed name)
_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This _____ day of _____, 20____ A.D.

Notary Public in and for the state of _____

FORM 2: UNCONDITIONAL WAIVER FOR PROGRESS PAYMENTS

PROJECT NAME: _____
OWNER'S NAME: _____ PROJECT NUMBER _____

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON PROGRESS PAYMENT

The signer of this document has been paid and has received a progress payment in the sum of \$_____ for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of _____ (Owner) located at _____ (location) to the following extent: _____ (job description). The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the above referenced project to the following extent:

This release covers a progress payment for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) as indicated in the attached statement(s) or progress payment request(s), except for unpaid retention, pending modifications and changes, or other items furnished.

The signer warrants that the signer has already paid or will use the funds received from this progress payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date _____
_____ (Company name)
By _____ (Signature)
_____ (Printed/Typed name)
_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This ____ day of _____.
20____ A.D.

Notary Public in and for the state of _____

FORM 3: CONDITIONAL WAIVER FOR FINAL PAYMENTS

PROJECT NAME: _____

OWNER'S NAME: _____ PROJECT NUMBER _____

CONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project _____

Job. No. _____

On receipt by the signer of this document of a check from _____ (maker of check) in the sum of \$_____ payable to _____ (payee or payees of check) and when the check has been properly endorsed and has been paid by the bank on which it is drawn, this document becomes effective to release any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position that the signer has on the property of _____ (owner) located at _____ (location) to the following extent:
_____ (job description).

This release covers the final payment to the signer for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted).

Before any recipient of this document relies on this document, the recipient should verify evidence of payment to the signer.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project up to the date of this waiver and release.

Date _____

_____ (Company name)

By _____ (Signature)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This ____ day of _____.
20____ A.D.

Notary Public in and for the state of _____

FORM 4: UNCONDITIONAL WAIVER FOR FINAL PAYMENTS

PROJECT NAME: _____

OWNER'S NAME: _____ PROJECT NUMBER _____

NOTICE: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. IT IS PROHIBITED FOR A PERSON TO REQUIRE YOU TO SIGN THIS DOCUMENT IF YOU HAVE NOT BEEN PAID THE PAYMENT AMOUNT SET FORTH BELOW. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.

UNCONDITIONAL WAIVER AND RELEASE ON FINAL PAYMENT

Project _____

Job. No. _____

The signer of this document has been paid in full for all labor, services, equipment, or materials furnished to the property or to _____ (person with whom signer contracted) on the property of _____ (owner) located at _____ (location) to the following extent: _____ (job description). The signer therefore waives and releases any mechanic's lien right, any right arising from a payment bond that complies with a state or federal statute, any common law payment bond right, any claim for payment, and any rights under any similar ordinance, rule, or statute related to claim or payment rights for persons in the signer's position.

The signer warrants that the signer has already paid or will use the funds received from this final payment to promptly pay in full all of the signer's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or services provided for or to the above referenced project in regard to the attached statement(s) or progress payment request(s).

Date _____

_____ (Company name)

By _____ (Signature)

_____ (Printed/Typed name)

_____ (Title)

SWORN AND SUBSCRIBED before me at _____, _____, This ____ day of _____.
20____ A.D.

Notary Public in and for the state of _____

(END OF ATTACHED FORMS)

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect or by uploading to web-based project software site or by email to Architect. Enable reviewer comments on draft submittals.
 - 2. Submit one paper copy.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
 - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.

2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.

3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.

2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.

2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.

4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative and procedural requirements for project record documents, including but not limited to:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings:
 - 1. Number of Copies: Submit one set of marked up record prints.
 - 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one set of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
 - 4) The contractor shall provide the following drawings full size laminated showing valves, disconnects, pull boxes, cleanouts, damper locations, duct detectors, smoke detectors, FCP and all related maintenance and control elements. Submit a paper copy and pdf prior to lamination for acceptance by the Owner:
 - a) The Mechanical plan of the whole building (2) copies
 - b) The Electrical plan of the while building (2) copies
 - c) The Plumbing drawing of the whole building (2) copies
 - d) Fire Detection plan of the whole building (2) copies
 - e) Network/Data/Security/Camera plan of whole building (2) copies
 - f) An enlarged plan at $\frac{3}{4}''=1''$ for the Fire Riser Room, Each Mechanical Room, Each Electrical Room, and the Chiller yard or similar outdoor equipment areas if separate
- B. Record Specifications: Submit one annotated PDF electronic file of the Project Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one annotated PDF electronic file and directory of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: Refer to the individual Specification Sections for miscellaneous record keeping requirements and submittals in connection with various

construction activities. Submit one annotated PDF electronic files and directories of each submittal.

- E. Reports: Submit written report monthly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 PROJECT RECORD DOCUMENT PROCEDURES

- A. Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference.
 - 1. Do not use As Built Drawings and Specifications for Record Drawings and Specifications.
- B. Recording Procedures: Update drawings and specifications on daily bases to record actual conditions. Record information concurrently with construction progress. Do not conceal Work until required information is accurately recorded.
- C. Store Record Documents and samples apart from as built documents used for construction.
 - 1. Label and file Record Documents and samples in accordance with section number listings in Table of Contents. Label each document *PROJECT RECORD* in neat, large, printed letters.
 - 2. Maintain Record Documents in clean, dry and legible condition.
 - 3. Make Record Documents and samples available for inspection upon request of Architect.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked up paper copies of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked up record prints. Show actual installation conditions where installation varies from that shown originally.
 - a. Give attention to information on concealed elements difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross reference record prints to corresponding shop drawings or archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.

- m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked up record prints.
 - 4. Mark record sets with erasable, red colored pencil. Use colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked up record prints with Architect. When authorized, prepare full set of corrected digital data files of the Contract Drawings:
- 1. Format: Same digital data software program, version, and operating system as the original Contract Drawings and annotated PDF electronic file with comment function enabled.
 - 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 - 3. Refer instances of uncertainty to Architect for resolution.
 - 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. Refer to Section 01 33 00 for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
- 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or modification.
 - 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation *PROJECT RECORD DRAWING* in a prominent location.
- 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file with comment function enabled.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation PROJECT RECORD DRAWINGS.
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Indicate actual product installation where installation varies from that indicated in Specifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file and marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 RECORD SAMPLES

- A. Record Samples: Determine with Architect and Owner which submitted Samples are to be maintained as Record Samples. Maintain and mark one set to indicate date of review and approval by Architect; note any deviations or variations between reviewed sample and installed product or material.

2.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by the individual Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Include the following:
 - 1. Reviewed shop drawings, product data, and samples.
 - 2. Field test reports.
 - 3. Inspection certificates and manufacturer's certificates.
 - 4. Inspections by authorities having jurisdiction (AHJ).
 - 5. Documentation of foundation depths.
 - 6. Special measurements or adjustments.
 - 7. Tests and inspections.
 - 8. Surveys.
 - 9. Design mixes.

- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked up miscellaneous record submittals. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.
 - 4. O&M Manuals should be uploaded into Owner's designated software (Prolog)

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules utilizing manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date of video recording.
 - 2. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.

- e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner through Program Manager with at least 10 days' advance

notice.

- C. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
- B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

3.4 TRAINING SCHEDULE

- A. The owner will participate in training for at least the following. In all cases provide 48 hours notice. (To the Architect – Include these and any others you feel are necessary or industry standard and the district can review and elect to participate or not. Provide a list of all training you propose prior to final specifications for the district to approve.)
 - 1. Technology Systems
 - 2. Doors and Hardware
 - 3. Generators
 - 4. Chillers
 - 5. Boilers
 - 6. Elevators
 - 7. Fire pumps if present
 - 8. Water plants if present
 - 9. Sound Systems
 - 10. Public Announcement Systems
 - 11. Fire Control Panel operations
 - 12. Water Softeners
 - 13. All other major MEP equipment
 - 14. Include the district in a Building Automation System walk prior to the Fire Marshall walk. Provide 48 hours notice.

END OF SECTION 01 79 00

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Furnishing all labor, materials, and equipment necessary for demolition, dismantling, cutting, and alterations as indicated, specified, and required for completion of the Contract, as applicable. Includes items such as the following:

1.3 RELATED REQUIREMENTS

- A. Section 00 31 00 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.
- B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- C. Section 01 10 00 - Summary: Sequencing and staging requirements.
- D. Section 01 10 00 - Summary: Description of items to be removed by Owner.
- E. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- F. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- G. Section 01 57 13 - Temporary Erosion and Sediment Control.
- H. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- I. Section 01 73 00 - Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- J. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- K. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.
- L. Section 31 22 13 - Rough Grading: Topsoil removal.
- M. Section 31 22 13 - Rough Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- N. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- O. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- P. Section 32 93 00 - Plants: Relocation of existing trees, shrubs, and other plants.
- Q. Section 32 93 00 - Plants: Pruning of existing trees to remain.

1.4 REGULATORY REQUIREMENTS:

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Vegetation to be protected.

2. Areas for temporary construction and field offices.
3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 2. Identify demolition firm and submit qualifications.
 3. Include a summary of safety procedures.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.6 EXISTING CONDITIONS

- A. The Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during work, notify Architect promptly for instructions. Failure to notify will make the Contractor liable for damage to these utilities arising from the Contractor's operations subsequent to discovery of such unknown active utilities.
- B. Conduct demolition to minimize interference with adjacent structures or items to remain. Maintain protected egress and access at all times.

1.7 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

- A. The Contractor shall acquaint himself with all site conditions. If unknown active utilities are encountered during Work, notify the Architect promptly for instructions. Failure to notify will make The Contractor liable for damage to these utilities arising from the Contractor's operations subsequent to discovery of such unknown active utilities.
- B. Conduct demolition to minimize interference with adjacent structures or items to remain. Maintain protected egress and access at all times.

3.2 SCOPE

- A. As indicated on Drawings.

3.3 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 73 00 - Execution.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 1. Obtain required permits.
 2. Comply with applicable requirements of NFPA 241.
 3. Use of explosives is not permitted.
 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.

9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from the Owner.
 - D. Do not begin removal until built elements to be salvaged or relocated have been removed.
 - E. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
 - F. Protect existing structures and other elements that are not to be removed.
 1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
 - G. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
 - H. If hazardous materials are discovered during removal operations, stop work and notify the Architect and the Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
 1. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

3.4 PROTECTION

- A. Adequate protection measures shall be provided to protect workmen and passers-by on and off the site. Adjacent property shall be fully protected throughout the operations. Blasting will not be permitted. Prevent damage to adjoining improvements and properties both above and below grade. Restore such improvements to original condition should damage occur. Replace trees and shrubs outside building area disturbed by operations.
- B. In accordance with generally accepted construction practices, Contractor shall be solely and completely responsible for working conditions at the jobsite, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and shall not be limited to normal working hours.
- C. Safety precautions prevent damage to existing elements identified to remain or to be salvaged and prevent injury to the public and workmen engaged onsite. Demolish roofs, walls, and other building elements in such a manner that demolished materials fall within foundation lines of building. Do not allow demolition debris to accumulate onsite. Pull down hazardous work at end of each day; do not leave standing or hanging overnight, or over weekends:
 1. Protect existing items that are not indicated to be altered. Protect utilities designated to remain from damage.
 2. Protect trees, plant growth, and features designated to remain as final landscaping as indicated on Drawings.
 3. Protect bench marks from damage or displacement.
- D. Any construction review of the Contractor's performance conducted by the geotechnical Engineer is not intended to include review of the adequacy of Contractor's safety measures in, on, or near the construction site.

3.5 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.

- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.6 PREPARATION

- A. Scheduling:
 - 1. General: Coordinate and schedule demolition work as required by the Owner and as necessary to facilitate construction progress.
- B. Hazardous Materials:
 - 1. General: Identify chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations, and notify such jurisdictional agencies as may be required. Collect and legally dispose of such materials at official disposal locations away from the site.
 - 2. Asbestos: If asbestos or materials containing asbestos are encountered, stop work immediately and contact the Owner. Do not proceed with demolition until directed by the Owner.
- C. Utility and Service Termination:
 - 1. Locate and identify existing utility, service, and irrigation system components affected by Work of this Contract. Review existing record Drawings, conduct site investigations, contact Underground Service Alert and other qualified cable/pipe/line locator services, and implement all other means necessary to define the location of underground systems.
 - 2. Prior to beginning any demolition, properly disconnect all water, gas, and electrical power supply at appropriate disconnect locations. Obtain all necessary releases and approvals from serving utility companies.
 - 3. Prior to demolition or disconnect, obtain the Owner's approval that such system does not impact facilities or systems beyond the extent of this Contract.
 - 4. Mark location of disconnected systems. Identify and indicate stub-out locations on Project record documents.
- D. Verify that existing plant life and features designated to remain are tagged or identified.
 - 1. The Architect will mark the features, trees, and shrubs to remain within the construction area. The Contractor shall not commence clearing and grubbing operations until authorized by the Owner and all protective measures are in place.
- E. Coordinate the time and duration of all system disconnects with the Owner.

3.7 DEMOLITION

- A. General Requirements:
 - 1. Clear areas required for access to site and execution of Work, including pavement, structures, foundations, vegetation, trash, and debris.
 - 2. Coordinate with the Owner the time of day and route to remove demolished materials from premises.
 - 3. Remove demolished materials from site as work progresses. Upon completion of work, leave areas of work in clean condition.
 - 4. Remove all buried debris, rubble, trash, or other material not deemed suitable by the geotechnical Engineer.

5. Fill all voids or excavations resulting from clearing, demolition, or removal of vegetation with specified fill material.
- B. Fixture and Equipment Removal:
 1. Remove existing fixtures and equipment as identified and shown on Drawings and required by the Architect.
 2. Verify all service connections to fixtures and equipment designated for removal have been properly disconnected.
 3. Remove all conductors from conduit at all abandoned circuits.

3.8 UTILITY AND BUILDING SERVICES REMOVAL AND RE-INSTALLATION

- A. Where crossing paths and potential points of interference with existing utility services are shown or can be reasonably inferred from surface conditions or evidence of subsurface systems, such as meter boxes, vaults, relief vents, cleanouts, and similar components:
 1. Review all Contract Documents showing crossing paths and potential points of interference.
 2. Pot-hole or determine by other means the accurate depth and location of such utilities.
 3. Incorporate all costs required to complete work under this Contract, including additional trenching, re-routing of existing and new utilities, and all means necessary to construct work under this Contract.
 4. No additional cost to Owner will be allowed for work necessary to accommodate utility conflicts where such crossing paths are shown on Contract Drawings or can be reasonably inferred from surface conditions or components.
- B. Remove all conductors from conduit at all abandoned electrical circuits.
- C. Seal off ends of all piping, drains, and other components as directed by Architect and serving utility.
- D. Where necessary to maintain service to existing utility and building systems, relocate or redirect all conduit and conductors, piping, drains, and associated system components:
 1. Re-circuit all electrical as required.
 2. Re-circuit all landscape irrigation valving and control systems as required.
 3. Temporarily terminate landscape system components in approved boxes or with approved caps, suitable for re-connection or extension.
 4. Extend or otherwise modify all site drainage systems, including catch basins, drain inlets, and piping. Fine grade to maintain proper drainage flow pattern to drains.
- E. Demolish structure in an orderly and careful manner:
 1. Use of explosives prohibited.

3.9 DEBRIS AND WASTE REMOVAL

- A. Demolished materials become property of the Contractor and shall be removed from premises, except those items specifically listed to be retained by the Owner.
- B. Remove debris, junk, and trash from site on a daily basis.
- C. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
- D. Leave site in clean condition, ready for subsequent work.
- E. Clean up spillage and wind-blown debris from public and private lands.

3.10 CLEANING

- A. Upon completion of work of this Section, promptly remove from the working area all scraps and debris.
- B. Clean excess material from the surface of all remaining paved surfaces and utility structures.

- C. Power wash all concrete surfaces to remove stains, dried mud, tire marks, and rust spots.

END OF SECTION 02 41 00

SECTION 02 41 19 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 01 35 91 "Historic Treatment Procedures" for historic removal and dismantling.
 - 3. Section 01 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
 - 4. Section 01 56 00 "Temporary Jobsite Protection" for temporary protection of architectural items.
 - 5. Section 01 73 00 "Execution" and 01 73 29 "Cutting and Patching" for cutting and patching procedures.
 - 6. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged; or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- E. Deconstruct: To remove by disassembling or detaching an item from the surface, using methods and equipment to successfully prevent damage to the item and surfaces; and dispose of items unless indicated as salvaged or for reinstallation.

1.4 QUALIFICATIONS

- A. Demolition Subcontractor
 - 1. The demolition subcontractor shall meet the following qualification requirements:

- a. The demolition subcontractor company shall have a minimum of five (5) years of demolition and temporary shoring experience of similar size, scale, and complexity of the demolition work involved in this project.
 - b. The site superintendent or foreman shall have the same required experience.
 - c. At a minimum, a demolition subcontractor shall have a representative who has completed OSHA 30 training and be present on site during all demotion and temporary shoring activities.
 - d. Any demolition subcontractors with OSHA violations within the past 5 years or are under active OSHA investigations will not be considered qualified for structural demolition.
 2. In cases where the general contractor wishes to employ multiple demolition subcontractors for various demolition scope, all demolition subcontractors shall meet the above qualifications.
- B. Demolition And Temporary Shoring Delegated Design Engineer
1. The structural EOR is not responsible for the design of any temporary shoring or bracing required between demolition and the installation of the new structure. The demolition and temporary shoring delegated design engineer shall be a licensed professional engineer in the state of Texas who specializes in Demolition and temporary structures. The delegated design engineer is responsible for the following:
 - a. Provide a letter stating that they fully understand the scope of work required from all disciplines.
 - b. Shoring plans and demolition plans, which includes the sequence of shoring, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
 - c. Excavation support and protection system plans, which includes the sequence of support & protection system, sequence of demolition, and duration of both signed and sealed by the qualified professional engineer responsible for their preparation.
 - d. Perform periodic site visits which include various milestones for the demolition and shoring subcontractors and shall provide observation report, photos, etc. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed. Measurements shall be taken at milestones.

1.5 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.6 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
 1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review and finalize protection requirements.
 5. Review areas where existing construction is to remain and requires protection.
 6. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 7. Review procedures for noise control and dust control.
 8. Review procedures for protection of adjacent buildings.

9. Review items to be salvaged and returned to Owner.
10. Site walk of all areas of selective demolition activities with the delegated design demolition engineer, structural engineer of record, architect, owner, general contractor, and demolition subcontractor representatives overseeing demolition work in attendance.
 - a. GC shall have removed superficial/architectural coverings so that structure is visible during site walk.

1.7 OAC MEETINGS

- A. The General Contractor shall provide a “two-week look ahead” to indicate upcoming areas where demolition work is scheduled to take place, so all parties are aware of timeline and any coordination with architect and consultants can take place. The highlighted plan should be completed by the General Contractor (in conjunction with their demolition subcontractor) and be available for discussion at the weekly OAC meeting.

1.8 SUBMITTALS

- A. For Information Only Submittal: Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
- B. For Information Only Submittal: Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services, if any.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 6. Refer to Section 1.7 for “two-week look ahead” requirement at OAC meetings.
- C. For Information Only Submittal: Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Pre-demolition photographs or videos showing existing conditions for any existing walls or new openings in existing walls, floors, and/or roofs scheduled to be demolished for the structural EOR's review and approval prior to the start of demolition. Photos must show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. The locations of pre-demolition photographs & videos shall be identified on an accompanying plan view.
- E. For Information Only Submittal: Demolition Sub-Contractor(s) qualifications required prior to demolition work commencing. Provide the following documentation:
 1. Demolition Subcontractor Company(s):
 - a. Provide the company's project experience in structural demolition for the past 5 years including the scope of work they performed and references with contact information.
 - b. Disclosure of any OSHA violations within the past 5 years and/or any active OSHA investigations.
 - c. Any company name changes for the past 10 years.
 2. Demolition site superintendent(s) / foreman(s)

- a. Provide the names of the structural demolition site superintendent(s) / foreman(s), their project experience for the past 5 years including the scope of work they performed and references with contact information
 - b. Proof of the individuals' completion of OSHA 30 training.
- F. For Information Only Submittal: Demolition & temporary shoring delegated design engineer letter stating they fully understand the scope of work required from all disciplines.
- G. Delegated-Design Submittal: Shoring plans and demolition plans, which includes sequence of shoring, sequence of demolition, and duration of both signed and sealed by the temporary shoring professional engineer responsible for their preparation.
 - 1. Locations for each shoring and demolition event provided in the sequence of shoring and demolition shall be indicated on the shoring and demolition plan to avoid any confusion as to where these activities should occur.
 - 2. These plans shall include the general contractors' field verification comments as described in Section 1.10 Field Conditions.
- H. Delegated-Design Submittal: For temporary shoring system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. This shall be submitted with the shoring and demolition plan delegated-design submittal.
 - 1. Provide a plan with temporary shoring system locations, the amount of load the shoring system will see at each location, the type shoring system used at each location, product data showing the load rating for each shoring tower type used on the project.
- I. For Information Only: Observation reports with site photos for periodic site visits at various demolition and shoring milestones prepared by the demolition and temporary shoring delegated design engineer.
 - 1. Baselines shall be set prior to temporary shoring and shortly after temporary shoring is installed.
 - 2. Measurements shall be taken at milestones.
- J. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions. Note locations and capping depth of wells and well points.
- K. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.9 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.10 FIELD CONDITION

- A. All existing structure shown on the plans are based on limited existing drawings / as-builts of the existing building, in-person site observations, and assumed framing based on the floor plan layout and may not be entirely accurate, complete, or representative of existing conditions. The general contractor shall not demolish any walls, columns, framing, wall openings, floor openings, or roof openings that are not shown and noted to be demolished on the structural demo plans, regardless of if these items are shown to be demolished on the architectural demo plans or any other disciplines' demo plan without structural engineer-of-record (EOR) review & approval. Care

should be taken during demolition to avoid damaging any structural elements that have been designated to remain.

- B. The general contractor shall field verify the location and size of all structural members shown on the plans prior to beginning any demolition work. Gridlines are shown on the structural drawings, and these reflect assumed architectural and structural dimensions. In most cases, grid lines coincide with existing column and pilaster centerlines. If actual field dimensions, or the location and sizes of existing structural members vary, notify the architect, structural EOR, and demolition & temporary structures delegated design engineer. The contractor shall notify the structural EOR of questionable existing structural components (masonry walls, steel beams and lintels, exposed foundations, etc.) and framing connections when encountered. The contractor shall verify that any wall, masonry or otherwise, to be demolished is a non-load bearing wall prior to beginning demolition. If a wall is found to be load bearing, the contractor shall contact the architect and structural EOR before proceeding.
- C. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- D. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
- E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.11 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- C. LEED Requirements for Building Reuse:

1. Credit MR 1.1 and Credit MR 1.2: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
3. Credit MR 1.2 and Credit MR 1.3: Maintain existing non-shell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
 2. Steel Tendons, if any: Locate tensioned steel tendons and include recommendations for de-tensioning.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, or preconstruction videotapes as appropriate.
 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly
- B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished and then break up and remove.
 - 1. Foundation at new underground plumbing lines: General contractor shall not core through existing grade beams to install new plumbing lines without review and approval from structural EOR. GC shall submit the following information for structural EOR review for new pipe penetrations in existing grade beams:
 - a. Existing grade beam width, depth, and bottom of grade beam elevation in relation to the FFE for grade beams with new pipe penetrations.
 - b. Existing foundation (piers or spread footing) locations supporting the existing grade beams with new pipe penetrations.
 - c. The planned pipe penetration opening size and the elevation of the center of the new opening in relation to the FFE.
 - d. The planned pipe penetration opening location in relation to the nearest foundation on both sides of the opening.
- D. Existing foundation demolition:
 - 1. At any location where a new foundation will overlap an existing foundation
 - a. The soil currently in the existing foundation shall be excavated. The resulting hole shall be backfilled with controlled low-strength material (CLSM) or flowable fill. CLSM / flowable fill shall meet the desired strength at the time of excavation. If foundations are planned to be excavated and completely removed, the geotechnical engineer should be contacted for additional recommendations.
 - 2. At any location where an existing footing/pier does not overlap with a new pier:
 - a. The portion of the existing footing/pier within 1-ft of bottom of new grade beams shall be demolished. The area between the top of the existing footing/pier and the bottom of the future slab shall be backfilled with select fill. The select fill should be placed in 8" thick max loose lifts, with each lift compacted to at least 95 percent of the maximum dry density determined by standard effort (ASTM D 698).
 - 3. While it is common for the testing and inspections laboratory to be involved and on-site during earthwork prep. and operations; (including but not limited to: observing and testing earthwork properties, select fill properties, thicknesses, compaction, moisture content, etc.) We also require the testing and inspections laboratory to be on-site for the infill of any and all demolished foundation items, both partially and fully demolished. We have observed instances where the demo contractor did not properly/adequately infill the sub-grade voids and/or compact the infill from existing demolished foundations. When the new building was constructed, the inadequate fill/compaction led to water intrusion problems and questionable bearing. We require that the testing and inspections laboratory be on-site to observe and test the infill of the existing foundations to reasonably ensure that the bearing values recommended in the geotechnical report can be achieved.
 - a. The owner shall be aware that this additional testing inspection scope will be required.
 - b. The general contractor shall inform the demolition contractor(s) that the infill of the demolished foundations will be required to meet the earthwork requirements and be testing for compliance and any additional cost associated with ensuring the infill meets these parameters shall be included in their base bid.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill unless otherwise directed by Owner.

1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION #02 41 19 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
 - 2. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.
 - 6. If needed, insert list of conference participants not mentioned in Section 013100 "Project Management and Coordination."

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.

- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Pre-demolition Photographs or Video: Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

3. Retain subparagraph below if hazardous materials are known to be present. Delete if Owner does not have, or will not provide, material safety data sheets for these materials.
 4. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.
- G. Storage or sale of removed items or materials on-site is not permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
 2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs.

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Work in Historic Areas: Selective demolition may be performed only in areas of the Project that are not designated as historic. In historic spaces, areas, and rooms or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 013591 "Historic Treatment Procedures."
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings. Do not use methods requiring solvent-based adhesive strippers.
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 3. Coordinate first subparagraph below with use of elevators, stairs, or building entries permitted by building manager.
 4. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 5. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Burning: Burning of demolished materials will be permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

- D. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.
- E. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Items to Be Removed: See construction drawings.
- B. Existing Items to Be Removed and Salvaged: See construction drawings.
- C. Existing Items to Be Removed and Reinstalled: See construction drawings.
- D. "Existing Items to Remain" Paragraph below may be used to inform Contractor of items that are to remain, such as those that occur in, or are adjacent to, construction being demolished, but are not being removed and reinstalled. Retain paragraph if required.
- E. Existing Items to Remain: See construction drawings.

END OF SECTION #02 41 19

PBK Architects, Inc.
PBK Project No. 240157

New CTE Center & Hargrave High School Additions & Renovations
Huffman Independent School District

SECTION 02 82 00 - ASBESTOS REMEDIATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Asbestos material abatement and disposal.
 - 2. Accessories necessary for complete removal.
- B. Related Sections:

1.3 REFERENCE STANDARDS

1.4 SUBMITTAL

- A. Submit one copy of the signed waste manifests indicating the place, time and exact quantity of asbestos, received by an approved landfill.

1.5 QUALITY ASSURANCE

- A. Qualifications: Entity having minimum 5 years documented experience, holding required current licenses for the removal, transport, and disposal and related activities relative to the work, having the required personal protective equipment and respirators for abatement operations, with current liability insurance, and who employs workers fully trained and knowledgeable in the removal of hazardous materials.
- B. Stop Asbestos Removal
 - 1. If a verbal or written Stop Asbestos Removal Order is given, immediately stop asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed Asbestos Contained Material (ACM).
 - 2. Do not resume asbestos removal activity until authorized to do so in writing by the Owner.
 - 3. A Stop Asbestos Removal Order may be issued at any time by the Owner if it is determined that abatement conditions/activities are not within regulatory requirements or that an imminent hazard exists to human health or the environment.
 - 4. Work stoppage will continue until conditions have been corrected.

PART 2 MATERIALS

2.1 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).

PART 3 EXECUTION

3.1 REMEDIATION

- A. The Owner has conducted an asbestos survey and has determined that asbestos may be present in areas where work will be performed. The survey is made available for review.
 - 1. As part of the work, the Owner requires asbestos removal to be performed under the construction contract.
 - 2. Asbestos may be present in vinyl tile under architectural woodwork or covered by, but not encapsulated, carpet materials and other types of flooring.
 - 3. Asbestos may be present in the ductwork above the ceiling panels.
 - 4. If asbestos is found, stop work in the area and engage an asbestos removal firm to remediate the asbestos from the area. Do not resume work in the affected areas until the abatement is complete and authorization to proceed with work in the affected areas is given. Work in areas not affected by asbestos may continue.

- B. Assume responsibility and liability for compliance with applicable Federal, State, and Local regulations related to the asbestos abatement work.
 - 1. Provide and maintain training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations.
 - 2. Post required notices prior to the commencement of the work.
 - 3. Restrict access to containment areas to authorized, trained, and protected personnel.
 - 4. Prepare and post an emergency plan in clean room and equipment room of the decontamination unit.
 - 5. Do not permit workers to eat, drink, smoke, chew gum or tobacco, or break the protection of the respiratory protection system in the work area.
- C. Entering and Exiting Procedures: Establish procedures for entering and exiting containment area. Provide personnel decontamination unit with disposable coveralls, head covers, and clean respirators. Provide shower room between personnel decontamination area and equipment room.
- D. Decontamination Procedures: Establish procedures for decontamination upon leaving containment are in accordance with federal and state regulations.
- E. Provide negative pressure filtration systems to complete exchange air 4 time per hour. Provide standby system in the event of a machine failure or emergency.
 - 1. Continuously monitor and record the pressure differential between the work area and the building outside of the work area.
- F. Prepare the Affected Area: Remove furnishings and materials to the extent necessary to remediate the asbestos.
- G. Containment of Areas:
 - 1. Provide a secure containment work area in accordance with federal and state regulations. Avoid damage to existing partitions and ceilings scheduled to remain to the extent possible.
 - a. Establish critical barriers over each opening into the work area.
 - b. Close out vents and air ducts to prevent particulates from entering the HVAC system.
- H. Debris:
 - 1. Place contaminated debris in a designated location within the containment area.
 - a. Place debris in minimum 6 mil poly bags before removing from contaminated areas. Pass Clean or decontaminate bags and pass and pass through a double 6 mil flap doorway into another bag or fiber drum. Remove to disposal dumpster/gondola/vehicle. Do not permit unprotected personnel to come in contact with contaminated bags.
 - b. Remove and dispose of contaminated debris in compliance with local regulations.
- I. Testing: Perform required tests and inspections upon completion of the work. Collect air samples and analyze in accordance with regulations. Upon satisfactory conclusion of testing, remove critical barriers.
- J. After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:
 - 1. Remove equipment, materials, and debris from the project area.
 - 2. Package and dispose asbestos waste as required.
 - 3. Repair or replace all interior finishes damaged during the abatement work.
 - 4. Fulfill other project closeout requirements as specified elsewhere in this specification.

3.2 CERTIFICATE OF COMPLETION BY THE CONTRACTOR

- A. Submit a signed Certificate of Completion at the completion of the abatement and decontamination of the regulated area.

END OF SECTION 02 82 00

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete formwork, for the following:
 - 1. Footings and/or piers.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 33 00 "Architectural Concrete".
 - 3. Section 03 30 00 "Cast In Place Concrete".
 - 4. Section 03 20 00 "Concrete Reinforcing".
 - 5. Section 03 47 13 "Tilt Up Concrete".
 - 6. Section 03 38 16 "Unbonded Post Tensioned Concrete".
 - 7. Section 03 53 00 "Concrete Topping".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. American Concrete Institute (ACI):
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials
 - b. ACI 301 – Specifications for Structural Concrete for Buildings
 - c. ACI 318 – Building Code Requirements for Structural Concrete
 - d. ACI 347 – Guide to Formwork for Concrete
 - e. ACI SP-4 – Formwork for Concrete.

1.4 PERFORMANCE REQUIREMENTS

- A. Design and engineering of formwork, including shores, reshores, false work, bracing, and other temporary supports as well as determining when temporary supports and bracing can safely be removed after the specified curing time is the Contractor's responsibility.
- B. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

- C. If any post tensioned members exist on the project, the formwork supporting those elements shall:
 - 1. It is essential to take into account the stressing sequence of post-tensioned concrete in the design of the formwork. Any concrete element which is stressed can transfer its weight off the form work to the supporting concrete element in which case the forms for the supporting concrete element must be designed to support the entire load tributary of that element.
 - 2. Forms shall be designed and constructed to permit movement during stressing, both lifting and shortening of the concrete elements.
 - 3. Formwork supporting beams and girders shall be designed to support the weight of the beam or girder's entire tributary area.
 - 4. Formwork supporting post tensioned concrete elements shall not be removed until all concrete supported by the formwork has been fully stressed, but in no case shall the curing time before form removal be less than specified herein.
 - 5. Design, engineering, and production of shop drawings for the form work shall be performed under the supervision of a professional engineer.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Shop drawings for layout of pan type forms, if they exist on the project. Layout only - information and details about the support of these forms is not required, as it is the responsibility of the Contractor and his registered engineer
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- C. Manufacturer's product data and installation instruction for propriety materials used in exposed concrete work including form liners, release agents, form systems, ties, and accessories.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver form materials in manufacturer's packaging with installation instructions.
- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- B. Testing Agency Qualifications: Refer to Section 01 45 23.
- C. Layout and measurement of concrete forms and embedment's, required for work, performed by a licensed surveyor employed by the contractor.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Permanent Metal Forms for Slabs: Deck material, gauge and rib pattern shall be as noted on Drawings.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
 - 1. Pans shall be free of dents, irregularities, sag, rust or other deterioration.
 - 2. In areas permanently exposed to view, provide one piece units, manufactured to length between beams or ribs, or segmented units with reinforced butt-joint splices.
- F. Load-bearing Rigid Board Insulating Fill Under Slabs:
 - 1. Extruded Polystyrene Board Insulation: Comply with ASTM C 578, Type X, 15 psi minimum compressive strength, 1.30 lb./cu. ft. (21 kg/cu. m) .

- a. Owens Corning Insulating Systems, LLC, Toledo, OH 43659; www.owenscorning.com.
 - b. Thermal Resistance: (180-day real-time aging as mandated by ASTM C578, measured per ASTM C 518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
 - c. Blowing Agent Formulation: Zero ozone depleting.
 - d. Install according to manufacturer's recommended instructions.
 2. Expanded Polystyrene Board Insulation: Un-faced Flat Board Stock: Rigid, closed cell, expanded polystyrene (EPS) boards, UL certified, complying with ASTM C 578 Type VIII, 15 psi minimum compressive strength .
 - a. Insulfoam, a Carlisle Company, which is located at: 6004 N. Westgate Blvd. Suite 120 ; Tacoma, WA 98406; Toll Free Tel: 800-248-5995; Tel: 253-572-5111; Email: [requestinfo \(info@insulfoam.com\)](mailto:requestinfo@insulfoam.com); Web: www.insulfoam.com
 - b. Blowing Agent Formulation: Zero ozone depleting.
 - c. Install according to manufacturer's recommended instructions.
- G. Formwork Accessories
1. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
 2. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
 3. Expansion-Contraction Joint Filler Material: Bonded fabric of thickness indicated on Drawings composed of cellular fibers securely bonded together and uniformly saturated with asphalt complying with ASTM D 1751.
 4. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - a. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 5. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - a. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - b. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - c. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Class A, 1/8 inch for smooth-formed finished surfaces.

2. Class B, 1/4 inch
 3. Class C, 1/2 inch
 4. Class D, 1 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts that are attached to the formwork.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

4. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 3. Determine compressive strength of in place concrete by testing representative field-cured test specimens according to ACI 301.
- B. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
- C. In the absence of cylinder tests, formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit (10 degrees Celsius) for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit (10 degrees Celsius), that time period shall be added to the minimum listed time period.
- D. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span. Two-way conventionally reinforced slabs shall then be reshored until they attain the specified 28 day strength.
- E. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems that allow form removal without displacing shores. However, the Contractor must demonstrate, to the satisfaction of the Architect, that the early removal of forms will not result in excessive sag, distortion or damage to the concrete elements.
- F. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- G. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

- B. The Contractor shall be solely responsible for proper shoring and reshoring. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- C. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement. Reshores shall be located in the same position on each floor. No construction loads shall be placed on the new construction until all supporting reshores have been installed.
 - 1. Extend shores or reshores from ground to top level in structure three stories or less in height, unless noted otherwise.
 - 2. In structures over three stories in height, extend shores or reshores at least three levels under the level being placed. Extend shores beyond the minimum number of levels if required to ensure proper distribution of loads throughout the structure.
 - 3. In crawl spaces or basement, shores or reshores shall extend to mud pads seated firmly on the soil or to on grade construction.
- D. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- E. Bottom tier of reshores shall remain in place until the supported concrete has attained at least 85 percent of the specified 28-day compressive strength and construction loads in excess of 20 psf have been removed but not less than 14 days.

3.5 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be used in the Work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent.
- B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Otherwise, locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are to be installed.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform

color and texture. Do not apply cement grout other than that created by the rubbing process.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated or to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment

END OF SECTION 03 10 00

SECTION 03 11 00 - CONCRETE FORMWORK

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Work Included: Perform all work necessary and required for the construction of the project as indicated. Such work includes but is not necessarily limited to the furnishing and installing of forms for all cast-in-place concrete work as shown and noted on the drawings and specified herein, including the removal of forms at completion of concrete work.
- B. Related Work in Other Sections: The following items of associated work are included in other sections of these specifications:
 - 1. Excavating, filling, backfilling, and other earthwork operations.
 - 2. Furnishing and placing of reinforcing steel.
 - 3. Cast-in-place concrete.
 - 4. Filling of tie rod, bolt holes, and defects. Curing of concrete.
 - 5. Furnishing of dovetail anchor slots for masonry adjacent to concrete.
 - 6. Furnishing of anchor bolts and miscellaneous metal items to be embedded in concrete.
 - 7. All other carpentry work.
 - 8. Furnishing of sheet metal reglets to be embedded in concrete.

1.2 CODES AND STANDARDS

- A. The American Concrete Institute's "Recommended Practice for Concrete Formwork", ACI 347, and Chapter 4, ACI 301 are hereby made a direct part of this specification, and all concrete formwork included in this contract shall conform with the applicable requirements therein except as specified otherwise herein.

1.3 SHOP DRAWINGS

- A. For exposed concrete submit fabricating drawings of forms showing the jointing of facing panels, the location of form ties, and any necessary alignment bracing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms for exposed concrete at exterior of building: Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces (this includes all surfaces to receive a painted finished coat) with plywood, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Forms for exposed concrete at interior of building: Form concrete surfaces with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit. Use either 6" or 8" wide lumber, nominal 1" thickness, or plywood as specified for exterior exposed concrete, at Contractor's option. Use "BB FIR" or "MDO" grade plywood for underside of parking decks.

- C. Form Ties and Spreaders: Standard metal form clamp assembly, of type acting as spreaders and leaving no metal within one inch (1") of concrete face. Inner tie rod shall be left in concrete when forms are removed. No wire ties or wood spreaders will be permitted.
- D. Form Anchors and Hangers: Anchors and hangers used for exposed concrete shall not leave exposed metal at surface. Hangers supporting forms from structural steel shall be symmetrically arranged on supporting members to minimize twisting or rotation of member. Penetration of structural steel members will not be permitted.
- E. Form Coatings: Form coating shall be a polymeric material and shall contain no wax or oil.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF WORK

- A. The design layout, construction and removal of formwork shall be the sole responsibility of the Contractor.
- B. Earth Forms: If conditions warrant, and the approval of the Engineer is secured, earth trench forms for footings will be allowed. Where footings are placed on dry soil or pervious material, waterproof paper shall be laid over the earth surfaces to receive concrete. Soil may be thoroughly wetted to optimum moisture content prior to placing concrete in lieu of using waterproof paper.
- C. Formwork-General: Forms shall be constructed of sound material, shall be of the correct shape and dimensions, mortar tight, of sufficient strength, and so braced and tied together that the movement of men, equipment, materials, or placing and vibrating the concrete will not throw them out of line or position. Before reusing forms, or when using second-hand lumber for forms, same shall be cleaned and all nails removed therefrom. Forms shall be strong enough to maintain their exact shape under all imposed loads. Camber where necessary to assure level finished soffits. Forms shall be so constructed that they may be easily removed without damage to the concrete. Before concrete is placed in form, the horizontal and vertical position of the form shall be carefully verified, and all inaccuracies corrected. All welding and bracing shall be completed in advance of placing of concrete.
- D. Forms for Exterior Exposed Concrete (concrete to receive paint): Plywood panels shall be clean, smooth, uniform in size, and free from damaged edges and holes. Full size panels shall be used wherever possible. After construction, tape joints of plywood panels to prevent joint protrusions in concrete. Horizontal joints must be level and continuous. All edges of plywood must be backed to prevent separation. Use special care in the forming and stripping of the forms to protect the corners. Form inside corners with mitered boards so that no concrete is placed against form ends.
- E. Framing and Bracing: Framing, bracing, supporting members, and centering shall be of ample size and strength to safely carry, without deflection, all dead and live loads to which forms may be subjected, and shall be spaced sufficiently close to prevent any bulging or sagging of forms. Concrete out of line, level, or plumb will be cause for rejection of the whole work affected. Distribute bracing loads over base area on which bracing is erected. When placed on ground, protect against undermining or settlement.
- F. Tolerances:
 - 1. Variation from plumb in lines and surfaces of walls and arises shall not exceed 1/8 inch in 10 feet with maximum "in" and "out" variation occurring in not less than 20 feet.
 - 2. Variation in linear building lines from established position of columns, piers, or walls shall not exceed 1/4 inch in any bay of 20 feet or 1/2 inch in 40 feet or greater length.
 - 3. Variation in thickness of slabs and walls shall not exceed minus 1/4 inch or plus 1/2 inch.
 - 4. Variation from the level or from the grades indicated on the drawings:
 - a. In slab soffits, ceilings, and in arises

- In 10 feet.....1/4 inch.
In any bay or 20 feet max.....3/8 inch.
In 40 feet or more.....3/4 inch.
- b. For exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines.
- In any bay or 20 feet max.....1/4 inch.
In 40 feet or more.....1/2 inch.
5. Variation from level in floors or from the grade indicated: In any 10 feet.....1/4 inch.
6. Size and location of sleeves, pits, floor openings, etc., the location of bolts, inserts and fastenings: Plus or minus 1/4 inch.
7. Footings:
- a. Variation in dimensions in plan:
minus.....1/2 inch, plus.....2 inch.
- b. Misplacement or eccentricity: Two percent of the footing width in the direction of misplacement but not more than 2 inches. These tolerances for footings apply to the concrete only, and not to reinforcing bars or dowels.
- G. Chamfered Corners: As indicated, provide moldings in forms for all chamfering required. Moldings shall be 45-degree right triangle in profile of size required, milled from wood free from open defects.
- H. Form Ties: Form ties shall be of sufficient strength and used in sufficient quantities to prevent spreading of the forms. Ties shall be placed at least one inch away from the finished surface of the concrete. The use of ties consisting of twisted wire loops will not be permitted. Inner rods shall be left in concrete when forms are stripped. All form ties shall be spaced equidistant, and symmetrical, and shall line up both vertically and horizontally.
- I. Cleanouts and Access Panels: Provide removable cleanout sections or access panels at the bottom of all forms to permit inspection and effective cleaning of loose dirt, debris, and waste material. All forms and surfaces to receive concrete shall be cleaned of all chips, sawdust, and other debris and shall be thoroughly blown out with compressed air just before concrete is placed.
- J. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- K. Construction Joints: Construction joints shall be formed as specified in Section entitled "Cast-In-Place Concrete." Provide a surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints. Just prior to subsequent pour, remove strip and tighten forms to conceal shrinkage. Construction joints shall show no "overlapping" of concrete and shall, as closely as possible, present the same appearance as butted plywood joints. Joints in a continuous line shall be straight, true, and sharp.
- L. Embedded Items: Provisions shall be made for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, and other features. No wood other than necessary nailing blocks shall be embedded in concrete. Complete cooperation shall be extended suppliers of embedded items in their installation. Secure information for embedded items from other trades as required. All embedded items shall be securely anchored in correct location and alignment prior to placing concrete, electrical and telephone conduits shall be run in concrete only upon the written approval of the Engineer. Under NO circumstances will ALUMINUM CONDUIT be permitted in concrete. No conduit larger than 3/4 inch in diameter and no plumbing pipes of any size will be permitted in concrete walls, columns, or slabs.

- M. Opening for Items Passing Through Concrete: Frame openings in concrete where indicated on architectural, structural, plumbing, mechanical, or electrical drawings. Contractor shall establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections. Contractor shall be held responsible for proper coordination of all work of this nature in order that there will be no unnecessary cutting and patching of concrete. Any cutting and repairing to concrete required as a result of failure to provide for such openings shall be paid for by the Contractor at no additional expense to the Owner.
- N. Screed: Contractor shall set screeds and establish levels for tops of concrete slabs and leveling for finish on slabs. Shape slabs to drain where required or as indicated on drawings. Before depositing concrete, all debris shall be removed from the space to be occupied by the concrete, and forms shall be thoroughly wetted. Reinforcement and inserts shall be secured in position. Free-standing water shall be removed.
- O. Screed Supports: Screed supports for concrete over waterproof membranes and/or vapor-barrier membranes shall be of a cradles, pad, or base type which will not puncture the membrane. Staking through the membrane will not be permitted.
- P. Shores and False Work: Contractor shall be fully responsible for the proper strength, safety, and adequacy of all falsework, supports, posts, footing, etc., used on and in connection with work. Falsework and supports shall be adequate in size and strength to resist the loads imposed upon them without deformation, deflection, or settlement. Wedges in pairs or jacks shall be used where required to bring forms, shoring, or falsework for beams, girders, slabs, and other parts of the structure to the exact elevations and uniform bearing before placing concrete. Single wedges will not be permitted. Vertical and lateral loads shall be carried to ground by form-work system or by completed structure, after it has attained adequate strength. Submit manufacturer's data for patented shores, shore splicing, and methods of shore support.
- Q. Reuse and Coating of Forms: Thoroughly clean forms and recoat with specified form coating before each reuse. Do not reuse any form for exposed work which cannot be reconditioned to "like new" condition. Apply form coating to all forms in accordance with the manufacturer's specifications. Apply form coatings before placing reinforcing steel.
- R. Inspection: Prior to placing of any concrete, and after placement of reinforcing steel in the forms, Contractor shall notify the Engineer so that proper inspection may be made. Such notification shall be made at least 72 hours in advance of placing concrete to permit proper arrangements to be made for inspection.
- S. Rejection of Defective Work Due to Improper Forms: Any movement or bellying of forms during construction or variations in excess of the tolerances specified will be considered just cause for the removal of such forms and, in addition, the concrete work so affected. Reconstruction of forms and new concrete shall be furnished at no additional cost to the Owner.

3.2 REMOVAL OF FORMS AND SHORES

- A. The supporting forms and shoring shall not be removed until the members have acquired sufficient strength to support their weight and the loads superimposed thereon safely. The contractor will be responsible for obtaining competent personnel to determine not only the method of forming, but the sequence of removal to assure that this requirement is met. All form work shall be removed without damage to the concrete.
- B. The Contractor shall be guided in the removal of forms by ACI publication 347. The removal of forms and shoring shall be determined by the method of forming and supports. The removal of forms and shoring must be related to the strength of concrete as determined by tests of job-cured specimens in accordance with procedures outlined in ACI 347 and ACI 301 and test cylinders prepared in accordance with ASTM C31 with compression tests performed in accordance with

ASTM C39.

- C. Shoring shall be adequate in strength and shall be so designed and placed that the load from successive parts of the structure will be transmitted directly through the falsework without creating bending or shearing stresses in the concrete. Do not remove shores until supporting members have attained sufficient strength to carry the imposed loads.
- D. During the period that forms are in place on the concrete work, said forms shall always be kept wet.
- E. In removing plywood forms, no metal pinch bars shall be used, and special care shall be taken in stripping. Start at top edge or vertical corner where it is possible to insert wooden wedges. Wedging shall be done gradually and shall be accompanied by light tapping on plywood panels to crack them loose. Do not remove forms with a single jerk after it has been started at one end.
- F. Forms shall be left in place as long as possible to permit shrinkage away from concrete, and plywood forms shall be left in place until all other forms around are stripped and until there is no danger of damaging the concrete due to other work in the vicinity.
- G. Nothing herein shall be construed as relieving the Contractor of any responsibility for the safety of the structure.
- H. After stripping, Contractor shall properly protect all concrete from damage.

END OF SECTION 03 11 00

SECTION 03 11 19 – INSULATING CONCRETE FORMING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulating Concrete Form System (ICF).
 - 2. Temporary form alignment system, bracing, and false work requirements.
- B. Related Requirements:
 - 1. Section 03 20 00 - "Concrete Reinforcing" for ICF steel reinforcing material and placement requirements.
 - 2. Section 03 30 00 - "Cast-In-Place Concrete" for ICF concrete material and placement requirements.
 - 3. Section 06 10 53 - "Miscellaneous Rough Carpentry" for door and window bucks.

1.2 REFERENCES

- A. American Concrete Institute
 - 1. ACI 318: Building Code Requirements for Structural Concrete and Commentary
- B. ASTM International
 - 1. ASTM C 165: Standard Test Method for Measuring Compressive Properties of Thermal Insulations
 - 2. ASTM C 177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
 - 3. ASTM C 203: Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
 - 4. ASTM C 272: Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
 - 5. ASTM C 303: Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
 - 6. ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 7. ASTM C 578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
 - 8. ASTM D 1621: Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
 - 9. ASTM D 1622: Standard Test Method for Apparent Density of Rigid Cellular Plastics
 - 10. ASTM D 2126: Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
 - 11. ASTM D 2863: Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
 - 12. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 13. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - 14. ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials
 - 15. ASTM E 336: Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.
 - 16. ASTM E 2634: Standard Specification for Flat Wall Insulating Concrete Form (ICF) Systems
- C. International Code Council Evaluation Service

1. AC 12: Acceptance Criteria for Foam Plastic Insulation
 2. AC 15: Concrete Floor, Roof and Wall Systems and Concrete Masonry Wall Systems
 3. AC 353: Stay-in-place, Foam Plastic Insulating Concrete Form (ICF) Systems for Solid Concrete
- D. National Fire Protection Association
1. NFPA 259: Standard Test Method for Potential Heat of Building Materials
 2. NFPA 268: Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source
 3. NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
 4. NFPA 286: Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
- E. Southwest Research Institute
1. SwRI 99: Crawl Space Insulation Evaluation Protocol
- F. Uniform Building Code
1. UBC 26-3: Room Fire Test Standard for Interior Foam Plastic Systems
 2. UBC 26-4: Method of Test for the Evaluation of Flammability Characteristics of Exterior, Non-load-bearing Wall Panel Assemblies Using Foam Plastic Insulation
 3. UBC 26-9: Method of Test for the Evaluation of Flammability Characteristics of Exterior, Non-load-bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multi-Story Test Apparatus
- G. Underwriters Laboratories Inc.
1. UL 263: Fire Tests of Building Construction and Materials

1.3 DEFINITIONS

- A. Abbreviations and Acronyms:
1. EPS- Acronym for "Expanded Polystyrene" when referencing the insulating foam component of the Insulating Concrete Form System.
 2. ICF- Acronym for "Insulating (or Insulated) Concrete Form"
- B. Definitions:
1. Form Alignment System- a form alignment & scaffold system designed exclusively for use with Insulating Concrete Forms.
 2. Trained Installer: An installation contractor, who has received instructional training in the installation of the specified Insulating Concrete Form System from the manufacturer, and is capable of providing written certification of his training by the specified manufacturer of the system being installed.
 3. Technical Associate: Manufacturer's technical representative who has received instructional training in the installation of Insulating Concrete Form system and is in the capacity of supervising an installation crew on site.
 4. Window or Door Opening Buck- a pre-manufactured or site constructed frame assembly consisting of wood or plastic material (or combination thereof) used to frame a rough opening within the forming system that will retain concrete around the opening. The frame can also provide for subsequent anchorage of doors and windows within the wall assembly.

1.4 ACTION SUBMITTALS

- A. Bid Submission Documents:
 - 1. Contractor shall submit with bid proposal for this section written confirmation of:
 - a. Name of ICF Product forming the basis for the material cost of the bid.
 - b. Name of ICF Product forming the basis for the labor cost of the bid. If two different ICF products are involved in above, Contractor shall specify BOTH material AND Labor bids associated with each material.
 - 2. Contractor shall submit with bid proposal for this section, written qualifications of the subcontractor responsible for the form system installation (Trained Installer) designated to be installing the ICF product as follows:
 - a. The installing contractor must be either:
 - 1) An experienced ICF Contractor (Trained Installer) with minimum 3 years experience in commercial ICF construction or;
 - 2) A qualified masonry or traditional concrete forming contractor with minimum 5 years experience in commercial construction applications.
 - 3. The installing contractor must have demonstrated experience on supervising commercial construction projects with gross floor areas of 50,000 sq. feet or greater.
 - a. Submit project names and locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
 - 1. Technical Associate for form system shall submit relevant laboratory tests or data that validate product compliance with performance criteria specified prior to commencement of work in this Section.
 - 2. Submit copy of valid product evaluation report, demonstrating compliance with this specification and applicable codes.
- B. Manufacturers' Instructions:
 - 1. Submit copy of manufacturer's product installation manual
- C. Sample Warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Manuals: Provide copies of pertinent documentation as it relates to instruction on post repair, renovation, modification or service work with respect to the form system once occupancy commences.

1.7 QUALITY ASSURANCE

- A. Qualification- Installers:
 - 1. Contractor shall engage the services of a Trained Installer or Technical Associate for the duration of the work under this Section who has been trained in procedures pertaining to the correct installation of the specified form system (Trained Installer may already be the designated ICF Installing Contractor if providing credentials as such).
 - 2. Trained Installer/Technical Associate shall furnish proof of training documentation to Contractor prior to commencement of work under this Section.
- B. Regulatory Requirements:
 - 1. Form system manufacturer shall provide written documentation verifying compliance with one of the following:
 - a. ICC-ES Acceptance Criteria AC-308 "Stay-in-place, Foam Plastic Insulating Concrete Form (ICF) Systems for Solid Concrete", with valid listing in the report verifying qualification of form system for use in Types I through V construction as qualified under the governing Building Code for this project.

- b. IAS Accredited 3rd Party Certification confirming compliance to ASTM E 2634 - "Standard Specification for Flat Wall Insulating Concrete Forms" and verification that the system meets all testing and documentation requirements for use in Types I through V construction as qualified under the governing Building Code for this project.
- 2. Documentation as provided shall verify compliance to the following regulatory documents and standards:
 - a. Form system structural, and general performance assessment of properties of EPS foam and polypropylene materials assessment in accordance with the following standards:
 - 1) ASTM C 578: Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation (which includes results for);
 - 2) ASTM C 165: Standard Test Method for Measuring Compressive Properties of Thermal Insulation
 - 3) ASTM C 177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
 - 4) ASTM C 203: Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
 - 5) ASTM C 272: Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
 - 6) ASTM C 303: Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
 - 7) ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 8) ASTM D 1621: Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
 - 9) ASTM D 1622: Standard Test Method for Apparent Density of Rigid Cellular Plastics
 - 10) ASTM D 2126: Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
 - 11) ASTM D 2863: Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
 - 12) ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials
 - b. Finish attachment testing in accordance with:
 - 1) ASTM D 1761: Standard Test Methods for Mechanical Fasteners in Wood (Modified for Polypropylene Web assessment)
 - c. Surface Burning, Flash Ignition and Self Ignition Temperature Characteristics assessment of both plastic web and EPS form materials in accordance with:
 - 1) ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and of Burning of Plastics in a Horizontal Position
 - 2) ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
 - 3) ASTM D 1929: Standard Test Method for Determining Ignition Temperature of Plastics
 - d. Verification of performance and compliance of finishes for provision thermal barrier protection to foam plastic.
 - 1) NFPA 286: Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth or...
 - 2) UBC 26-3: Room Fire Test Standard for Interior Foam Plastic Systems
 - e. Crawl Space Installation Evaluation in accordance with:
 - 1) SwRI 99: Crawl Space Insulation Evaluation Protocol
 - f. Fire Resistance Rated Construction assessment in accordance with:

- 1) UL 263: Fire Tests of Building Construction and Materials
 - g. Non-Combustible Construction assessment (i.e. approved non-combustible material finish requirement documentation) in accordance with:
 - 1) NFPA 259: Standard Test Method for Potential Heat of Building Materials
 - 2) NFPA 268: Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source.
 - h. Assessment of non-combustible finishes verifying exterior protection of foam plastic insulation in accordance with one of the following standards:
 - 1) NFPA 285: Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
 - 2) UBC 26-4: Method of Test for the Evaluation of Flammability Characteristics of Exterior, Non-load-bearing Wall Panel Assemblies Using Foam Plastic Insulation or...
 - 3) UBC 26-9: Method of Test for the Evaluation of Flammability Characteristics of Exterior, Non-load-bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multi-Story Test Apparatus
 - i. Additional Testing and engineering documentation to verify qualification of EPS foam panels as a Vapor Retarder in conjunction with testing to:
 - 1) ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials
 - j. Testing and engineering documentation to verify qualification of fully assembled wall system as an air barrier element in accordance with:
 - 1) ASTM E 1677: Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls
 - k. Testing and engineering documentation to verify qualification of the form system as meets the minimum STC performance requirements of 50 in accordance with:
 - 1) ASTM E 90: Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements, or;
 - 2) ASTM E 336: Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings.
 - C. Sustainability Characteristics:
 - 1. When required by Architect/Engineer, Technical Associate for the form system shall provide, written documentation verifying product recycle content and manufacturing location compliances with respect to USGBC/LEED® document submissions.
 - D. Preinstallation Conference: Conduct conference at Project site.
 - E. Mock-ups:
 - 1. Construct sample wall mock-up panel, at least 8'-0" tall by 8'-0" wide, to include full wall system and details, located where directed by Architect.
 - 2. Mock-up panel shall consist of at least one full window opening, complete with sill, jamb, and head conditions.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Delivery and Acceptance Requirements:
 - 1. Trained Installer/Technical Associate to meet with Contractor prior to material delivery

on site to co-ordinate provision of access, storage area, and protection of insulating concrete form product and spatial requirements for Form Alignment System placement, steel storage, and forming.

2. Deliver products in original factory packaging, bearing identification of product, manufacturer and batch/lot number.
3. Trained Installer shall furnish product packaging labels to Contractor as required to maintain traceability of product for duration of contract.
4. Bulk of form shipment shall be delivered as pre-assembled units and folded flat to maximize shipping space. Only form panels and insert webs as may be required for floor interfaces or specialized construction on site are to be shipped unassembled but in labeled packages for traceability

B. Storage and Handling Requirements:

1. Handle and store products in location to prevent damaging and soiling.
2. Maintain form materials and accessories in original packaging, or provide similar protection to unpackaged form materials -should on-site storage prior to installation extend beyond three months.
3. Form units and related form installation materials and equipment to be stored flat until time of use.

1.9 COORDINATION

- A. Trained Installer for this Section shall provide list of known special requirements for interface of materials provided in this Section pertaining to coordination with mechanical, electrical, plumbing, interior and exterior finish trades prior to commencement of work.

1.10 PROJECT CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

- B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.

1.11 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace all EPS products that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide NUDURA Corporation; Integrated Building Technology ICF System, or comparable product by one of the following:
 - 1. BuildBlock Building System, LLC.
 - 2. Fox Blocks; a division of Airlite Plastics Company
 - 3. Reward Wall Systems

2.2 SYSTEM DESCRIPTION

- A. Insulating concrete form system shall consist of two (2) flame resistant panels of expanded polystyrene (EPS) connected by either high-density polypropylene hinged pin foldable webs or EPS embedded polystyrene fastening strips interconnected with slide in format - high density polypropylene web connectors. EPS foam panels shall feature continuous vertical dove tail grooves on interior panel surfaces to provide integral surface bonding to concrete core once filled and concrete is cured. Dove tail grooves shall also facilitate structural linkage with end cap forms placed into the form cavity where required as part of the overall architectural design layout.
- B. All web fastening strips to run full height of form and be fitted top and bottom with reversible fitting, "triple-tooth" interlocking mechanisms to enable positive vertical interlocking of forms with each other. Wall system webs to provide minimum 1 ½" wide fastening strips at 8-inches on center approx 5/8-inch below insulation face to facilitate finish fastening of both interior and exterior finishes.
- C. Insulating concrete form system shall be capable of forming ALL of following concrete core thicknesses: 4, 6, 8, 10 or 12-inches wall sections (as required for various locations throughout project scope with standard form line-up) (See form dimensions summary Attachments Table A at end of Section).
- D. Insulating concrete form system shall provide a minimum insulation panel thickness of 2 5/8-inches throughout ALL forms and panels forming the form system product inventory (with exception of variance required for brick ledge and tapered top forms).
- E. All form units of wall forming system shall be capable of being shipped to site in folded condition to minimize shipping cost and site storage space requirement and be capable of being deployed to installation ready condition by simply unfolding the unit in a single pull motion or pull motion combined with insertion of a single web (at corner condition).
- F. Standards, corner forms and stand alone panels of form system shall provide fully reversible interlocks along top and bottom edges to assure minimum product waste on site. EPS foam panels shall be molded with 1-inch wide by ½-inch high/deep alternating male/female reversible projection/socket interlocks positioned in pairs along both top and bottom edges of all panels.
- G. Wall system shall be capable of providing horizontal and vertical lock positioning of steel within form cavity to conform to all reinforcing requirements of ACI 318.

2.3 SYSTEM SERVICE REQUIREMENTS

- A. Where project scope permits, form units shall be supplied through an authorized distributor of the Manufacturer listed for the bid. The distributor shall be capable of providing product on site within 24 hours notice.
- B. The Manufacturer's authorized distributor shall have available local to the region, technical sales staff that can be contacted or even contracted (under separate contract) as may be required to provide timely on site problem resolution as installation or product supply issues

may arise.

- C. Where local distribution cannot service to the requirements of the contract scope and product is to be supplied directly by the manufacturer, the manufacturer shall provide on-site technical assistance as specified under Clause D of this section.
- D. Where product is supplied direct, technical assistance supplied by the manufacturer shall include the provision of a technical consultant direct from or contracted by the manufacturer for first week of contract that form product is to be erected on the site to coordinate form system installation, crew organization and set-up. During installation, (as agreed to with terms of Contractor), the manufacturer's technical consultant shall provide periodic site visits (as may required under separate contract) at key stages of form installation, to assure continued product installation quality.

2.4 SYSTEM PERFORMANCE CRITERIA

- A. Selected system in conjunction with concrete and designated exterior and interior finishes shall provide minimum insulation level of R 23.59 or RSI 4.158 -U Factor 0.2405 across full line of form unit cavity widths.
- B. EPS foam panels forming part of wall system shall provide maximum vapor permeation rate of 0.78 Perm-inch. based on 2 5/8-inches singles thickness of foam on interior surface of concrete core.
- C. Finished interior wall assemblies formed by system shall provide minimum sound transmission class (STC) sound attenuation performance as follows:
 - 1. 4-inch core form (if specified):
 - a. STC 42 when installed with 1/2-inch gypsum board on both sides.
 - b. STC 52 when installed as specified by manufacturer with additional hat channel and acoustic material with 5/8-inch finish on one side and 1/2-inch gypsum board on opposite side.
 - 2. 6-inch core form
 - a. STC 50 with regular 1/2-inch gypsum board on both sides.
- D. Finished insulating concrete form wall assembly shall be capable of providing fire resistance ratings as listed in this section. Manufacturers of the specified wall assembly number (BXUV.U930) shall be actively listed and classified with Underwriters Laboratories Inc. Listings.
- E. Fire resistance ratings shall be established by testing in full accordance with ANSI/UL 263 when installed as per the listed classification (BXUV.U930)
 - 1. 4-inch core form - 2 hour fire resistance rating
 - 2. 6-inch core form and above - 4 hour fire resistance rating
- F. Per BXUV.U930 Note 2- Wall reinforcement shall consist of minimum No. 4 Bar 60 ksi yield strength installed at 16-inches o/c vertically and 18-inches o/c horizontally.
- G. Per BXUV.U930 Note 3- Concrete shall be minimum 2900 psi compressive strength at 28 days and shall be a minimum density of 145 lbs +/- 5lbs /ft3 using regular siliceous concrete aggregate.
- H. Per BXUV.U930 Note 4- Finished wall assembly shall provide above noted fire resistance ratings using unclassified or classified 1/2-inch gypsum board finish (interior surface only for exterior walls and both sides for interior demising walls).
- I. When reinforced per BXUV.U930 Note 2, 6-inch load bearing wall must demonstrate being able

to be loaded to a minimum axially applied load of 40,000 lbs/lf for full 4-hour burn duration under above test conditions.

2.5 MATERIALS

- A. Insulating Concrete Forming:
 - 1. Provide Insulating Concrete Forming as listed in Appendix A as may be required for proper execution of the work.
- B. Concrete:
 - 1. Concrete shall be as specified in Section 03 30 00 – “Cast-In-Place Concrete,” with the following exceptions:
 - a. Maximum recommended aggregate sizes shall be as follows:
 - 1) ½-inch aggregate for 4 & 6-inch cavity forms.
 - 2) ¾-inch aggregate for 8-inch cavity forms and higher.
 - b. Recommended concrete slump is 4 to 6-inches, +/- 1-inch.
 - 1) Where required by engineer of record, recommended slump specification shall be attained through addition of super plasticizer/mid-range water reducing agents to achieve design mix strength and concrete flow-ability.
- C. Reinforcing Steel:
 - 1. Reinforcing steel shall be as specified in Section 03 21 00 “Concrete Reinforcing” and shall be supplied under that Section for placement by the Form System's Trained Installer.
- D. Waterproofing:
 - 1. Where required at below grade locations, waterproofing shall be self-adhesive modified bituminous sheet waterproofing membrane as supplied by concrete form system manufacturer specific to the form system specified under this section.
 - 2. Material to be supplied under this Section & installed as specified under Section 07 13 26 – “Self-Adhered Sheet Waterproofing”.
 - 3. Waterproofing material shall be EPS foam compatible.

2.6 ACCESSORIES

- A. Form Alignment System
 - 1. The Trained Installer shall furnish and utilize a Wall Access and Form Alignment System to facilitate construction of the wall assembly, and to provide adjustment for ensuring plumbness and straightness of the wall system during construction, just prior to concrete placement and immediately after concrete placement while form system is still adjustable to final finished position.
 - a. Delegated Design: For walls with over 12 feet of unsupported wall height, the Contractor shall provide scaffold engineering design for support of the Form Alignment System.
 - 2. Form Alignment System shall be OSHA compliant. Technical Associate shall supply engineering documentation pertaining to the "base" Form Alignment System components to verify compliance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:

1. Inspect all areas included in Part 1 Section 1.01 Summary to establish extent of work and verify site access conditions.
2. Verify that site conditions are as set out in Part 1- Section 1.10 Site Conditions.

B. Evaluation and Assessment:

1. Examine footings and grade beams to determine whether they are within $\pm 1/4$ - inch of level and that footing step-increments are 18-inches in height.
2. Where partial or half course is intended for starting course elevation, ensure step footing increment is equal to cut form unit, less $1/2$ -inch.
3. When specified, ensure reinforcing steel dowels are in place at specified centers along footing lengths.
4. Ensure reinforcement steel dowels have OSHA compliant protection installed until formwork is erected above dowel level.

3.2 PREPARATION

A. Surface Preparation:

1. Clean all debris from top of footings prior to commencement of insulating concrete form system installation.
2. Sequence installation of concrete formwork with related work specified in other sections to ensure that wall assemblies, including window and door accessories, trim, service penetrations, transition changes, and mechanical service are protected against damage from effects of weather, corrosion, and adjacent construction activity.

3.3 ERECTION/INSTALLATION

A. Installation Procedures:

1. Installation of forms to be in strict accordance with manufacturer's product installation manual as submitted under this Section.
2. The Trained Installer shall ensure all manufacturer's procedures for the following work are employed on site. Additional to all required procedures being followed, the Trained Installer shall specifically assure cross checks with respect to layout, leveling, and vertical alignment are executed as noted below in each section:
 - a. First Course Placement - perform cross checks for accuracy of plan layout to survey pins, marks or grid lines as set by the Contractor.
 - b. Horizontal Reinforcement Placement - assure reinforcement diameter, grade and positioning is accurate to engineering specifications on structural drawings and installed in correct axis of wall for each course placed.
 - c. Successive Course Placement - assure system is accurately leveled subsequent to 2nd course placement.
 - d. Door & Window Opening Construction - assure bucks have been prepared for anchorage with concrete and/or fitted with mesh attachments as may be required for subsequent exterior finishes such as acrylic stuccos or similar architectural coatings for non-combustible construction. Trained Installer shall also assure all top, bottom and stirrup steel fittings are installed per engineering specifications.
 - e. Form Alignment System /Installation - assure Form Alignment System is regularly checked for crew safety, anchorage to form system as specified, vertical alignment checks at both pre-placement of concrete as well.
 - f. Vertical Reinforcement Placement- assure reinforcement diameter, grade and positioning is accurate to engineering specifications on structural drawings and installed in correct axis of wall, prior to placement of concrete.
 - g. Pre-Concrete Placement Inspection- Trained Installer shall assure string lines are place at top of all pours and wall system aligned for placement, cross check and assure that all required service penetration sleeves, embed plates,

anchor bolts, fittings, beam pocket preparations, as specified on drawings are in place prior to commencement of concrete placement.

- h. Concrete Placement- Trained Installer shall assure concrete tickets retained for Contractor records and that slump, strength and aggregate size are as specified. Trained Installer to assure truck delivery timed for rate of placement and that placement does not exceed ACI recommended practices. Trained Installer shall also assure that concrete during lift placement is mechanically and internally vibrated per ACI Standards to assure full monolithic concrete placement for all areas of formwork.
- i. Form Alignment System and Scaffold Access Assembly, adjustment & removal. Trained Installer shall assure entire wall lengths aligned to vertical plumb by string line and screeded to horizontal level as required for finished wall height prior to concrete set. Subsequent to initial concrete cure, Contractor shall assure that scaffold access and Form Alignment System remains in place until removal is directed accordingly by engineer of record for the project.

B. Interface with Other Work:

- 1. Service penetrations (electrical service conduits, water service pipes, air supply and exhaust ducts etc.) shall be installed at the required locations as indicated by the appropriate trade.
- 2. Service penetrations exceeding 16" x 16" in area shall be reinforced per engineer specifications
- 3. Prior to concrete placement, install service penetration sleeves (supplied by others) at designated locations to create voids for service placement at later date.
- 4. Instructions for exterior finish application to be reviewed with each trade. Contractor shall contact Trained Installer for specific instructions where sub trade has insufficient information or specialty requirements not addressed in specification specific to ICF applications.

3.4 CLEANING

- A. Clean up and properly dispose of all debris remaining on job site related to the installation of the insulated concrete forms.

3.5 PROTECTION

- A. Assure final finishes are installed over form product or provide temporary coverage of installation to reduce EPS foam surface exposure to ultraviolet light should final finish application be delayed longer than 18 months after form product installation.
- B. Consult with exterior finish contractor concerning exposure of EPS to ultraviolet light to ensure proper finish to ICF walls.

END OF SECTION

SECTION 03 11 31 - VOID FORMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes corrugated paper void form material to create a temporary support for the placement of structural concrete slabs, grade beams, or walls over expansive soils.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 33 00 "Architectural Concrete".
 - 3. Section 03 30 00 "Cast In Place Concrete".
 - 4. Section 03 20 00 "Concrete Reinforcing".
 - 5. Section 03 47 13 "Tilt Up Concrete".
 - 6. Section 03 38 16 "Unbonded Post Tensioned Concrete".

1.3 PERFORMANCE REQUIREMENTS

- A. All components of the formwork shall be designed to support all loads imposed during construction including weight of construction equipment, live loads, and lateral loads due to wind and imbalance or discontinuity of building components.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated including manufacturer's written installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver form materials in manufacturer's packaging with installation instructions.
- B. Store off ground in ventilated and protected area to prevent deterioration from moisture or damage.

1.6 QUALITY ASSURANCE

- A. Design, place, and maintain void forms or carton forms for cast in place concrete work in compliance with ACI 347 "Guide to Form Work" unless otherwise shown or specified.
- B. Testing Agency Qualifications: Refer Section 01 45 23.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads, but not less than 800 pounds per square foot. Interior components shall be constructs as shown below:
 - 1. Extra Fast Decomposition – Non wax impregnated, plain kraft paper and a water soluble adhesive.
 - 2. Fast Decomposition – Non wax impregnated, plain kraft paper and a moisture resistant adhesive.
 - 3. Moderate Decomposition – Plain kraft paper with a wax impregnated medium, but non wax impregnated liners and a moisture resistant adhesive.
 - 4. Slow Decomposition – Plain kraft paper with wax impregnated medium / liners and a moisture resistant adhesive.
 - 5. Extra Slow Decomposition – Wet strength paper with wax impregnated medium / liners and a moisture resistant adhesive.

2.2 VOID BOXES

- A. Slabs: Use “Slab Void” with interior cell sizes 8”x8” or smaller, capable of sustaining a working load 800 psf, for slabs 8 inches thick or less. For slabs between 8 inches thick and 12 inches thick, void box shall be capable of sustaining a working load of 1000 psf. For slabs greater than 12 inches thick, consult with the structural engineer. For interior piers, provide pre-manufactured curved end units against top of piers for tight fit.
- B. Grade beams and walls: Rectangular shape as shown on plans. Trapezoidal void boxes are not acceptable. Provide end caps at ends of forms and corners. Provide pre-manufactured curved end units against top of piers for tight fit. Cartons shall be capable of sustaining a working load of 200 psf times the height of the pour (in feet), without significant deformation.
- C. Design and maintain void forms to maintain all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. This includes, but is not limited to, live load, dead load, and weight of moving equipment, height of concrete drop, vibrator frequency, ambient temperature, soil pressures, and lateral stability.
- D. Form material shall be designed to lose it strength upon prolonged contact with the moisture that normally accumulates beneath slabs and beams on grade. Sufficient deterioration to cushion uplift forces shall take place within a maximum of 8 weeks after placement of concrete.

2.3 RELATED PRODUCTS

- A. Protection Board: Used over carton forms under slabs and under grade beam or walls wider than 12 inches. 1/4-inch minimum hardboard.
- B. Soil Retainers: High density, polyethylene (HDPE). “Sure Retainer” by Motzblock or ½ inch thick “Backfill Retainer” by Sure Void Products. Retainers shall be sized such that they extend a minimum of 4 inches above the void box and 4 inches below the void box.

PART 3 - EXECUTION

3.1 CARTON FORMS

- A. A void shall be constructed below all structural elements supported by piers to separate these elements from the soil. Where carton forms are used to construct this void the construction shall comply with the following:
 - 1. Seal discontinuous ends of carton forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between carton form sections.
 - 2. Pre-manufactured carton forms with circular edges shall be used around all drilled piers. Cutting of square carton forms is not acceptable.
 - 3. Do not allow any portion of carton forms to fall within the circumference of piers causing reduction in bearing area.
 - 4. Protect carton forms from water. Do not install carton forms during wet weather or on wet ground. Carton forms which become wet prior to placement of concrete shall be removed and replaced.
 - 5. Protect carton forms, from puncturing, collapsing, or crushing during construction. All damaged carton forms must be replaced prior to concrete placement.
 - 6. Exercise care in placement of concrete to avoid collapse of carton forms. If carton forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created and protected by installing the specified soil retainers.
 - 7. Carton forms wrapped in plastic to protect them from water, shall have the plastic ripped or punctured immediately prior to concrete placement.
- B. Carton Forms Under Slabs
 - 1. Carton forms under slabs shall be protected on top by a protection board as specified with the specified vapor retarder on top of the protection board.
 - 2. Carton forms shall not be placed under soil supported slabs on grade.

END OF SECTION 03 11 31

SECTION 03 15 00 - CONCRETE ACCESSORIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Conditions of the Contract and the General Requirements are hereby made a part of this Section.

1.2 WORK INCLUDED

- A. The Work under this Section includes all material, labor, equipment and supervision to install anchor bolts, to install formwork and reinforcing steel for cast-in-place concrete and to epoxy coat exposed reinforcement as shown on the Drawings.

1.3 RELATED WORK

- A. The following work is related to this Section:

Demolition Section 02 41 16
Cast-in-Place Concrete Section 03 30 00

1.4 QUALITY ASSURANCE

- A. Materials and installed work may be reviewed by the Engineer at any time during the progress of the Work.

1.5 SUBMITTALS

- A. Contractor shall submit to the Engineer copies of the Manufacturers Specs. Data Sheets and Health and Safety Data Sheets for the following:

Reinforcement
Form Coating
Anchor Bolt Fastening System
Epoxy Coating
Permanent Compressible Joint Filler
Expansion Joint Assembly

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store all materials clear of ground, protected, so as to preclude damage.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Concrete Surfaces: APA exterior plyform BB or metal forms. Forms shall be clean and straight with mortar tight joints.

- B. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces to be cured with water or curing compound. Form oil shall be similar to that manufactured by Nox-Crete Company.

2.2 ANCHOR BOLT FASTENING SYSTEM

- A. Provide sizes indicated on the Drawings.

Provide one of the following embedded anchor systems:

1. "HILTI HIT Fastening System" By HILTI, Inc. Fastening Systems.
2. "HILTI HVA Adhesive Anchors" By HILTI, Inc. Fastening Systems.
3. "Molly Parabond Capsule Anchors" By Molly Fastener Group.
4. or Approved Equivalent.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ANSI/ASTM A615, grade 60 unless noted.
- B. Field Applied Epoxy Coating Materials for Existing Steel Reinforcement and Embedded Items.
- C. Provide one of the following epoxy coatings for existing steel reinforcement and miscellaneous metals that are to be embedded in concrete:
 1. "Sikagard 62 with Tan, Grey, Yellow or Green Pigment" by Sika Chemical Corp., Lyndhurst, N.J.
 2. or Approved Equivalent.

2.4 PERMANENT COMPRESSIBLE JOINT FILLER

- A. Joint filler in grout pockets and joints - as indicated on the Drawings. Acceptable products are:
 1. "Flexcell" by Celotex Corporation
 2. "Sonoflex F" by Sonneborn Building Products, Minneapolis, MN
 3. "Ceramar Flexible Foam E. J. Filler" by W.R. Meadows, Elgin, IL.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design: The design, engineering and proper construction of the formwork shall be the responsibility of the Contractor. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces, the structure and adjacent materials. Formwork shall be braced properly to prevent displacement under vibration or sagging between supports.
- B. Edge Forms and Screed Strips for Overlay: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed compacting type screeds.
- C. Preparation of Form Surfaces: Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- D. Removal of Forms: Concrete formwork shall not be disturbed until the concrete has hardened to be able to support its own weight.

- E. Re-Use of Forms: Clean and repair surfaces of forms to be re-used in Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
 - 1. Do not use "patched" forms for exposed concrete surfaces.
- F. Tolerances: Comply with tolerances for formed surfaces as defined in ACI 301, Chapter 4, except as herein modified.

3.2 ANCHOR BOLT FASTENING SYSTEM

- A. Install anchor bolts according to manufacturer's recommendations.

3.3 EPOXY COATING FOR EXISTING REINFORCEMENT

- A. Preparation: Existing reinforcing and miscellaneous metal to remain shall be cleaned of rust and latency to Near White Metal.
- B. Installation: Existing reinforcing and miscellaneous metals that are to be embedded in concrete shall be epoxy coated in accordance with manufactures recommendations. Epoxy shall be cured prior to concrete placement.

3.4 SUPPLEMENTAL REINFORCEMENT

- A. Placing Reinforcement: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
 - 1. Clean reinforcement of loose rust and mill scale, oil, earth and other materials which reduce bond with concrete.
 - 2. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations.
 - 3. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- B. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.

END OF SECTION 03 15 00

SECTION 03 15 13 - WATERSTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provision of waterstops embedded in concrete and spanning control, expansion, and/or construction joints to create a continuous diaphragm to prevent fluid migration.
- B. Non-metallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.
- C. Non-metallic waterstops for use in concrete joints subjected to acids, bases, alcohols, oils, solvents, or other chemicals.

1.3 REFERENCES

- A. PVC WATERSTOP
 - 1. Corps of Engineers: CRD-C 572-74
 - 2. American Society for Testing Materials (ASTM)
 - 3. Bureau of Reclamation: C-902
 - 4. Canadian General Standards Board: 41-GP-35M Types 1 & 3
 - 5. ACI 350.2: Concrete Structures for Containment of Hazardous Materials
- B. HYDROPHILIC WATERSTOP
 - 1. American Society for Testing Materials (ASTM)

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store waterstops under tarps to protect from oil, dirt, sunlight, and premature exposure to water.

1.5 SUBMITTALS

- A. Submit shop drawings and fabrication drawings indicating placement of waterstops and shop fabrications.
- B. Submit manufacturer's test data for chemical resistance.

PART 2 - PRODUCTS

2.1 PVC WATERSTOPS FOR EXPANSION JOINTS

- A. Provide flexible PVC (polyvinyl chloride) waterstop as manufactured by Greenstreak or approved equal.

- B. The PVC waterstop shall be extruded from an elastomeric plastic material of which the basic resin is prime virgin polyvinyl chloride. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.
- C. Profile: Ribbed with center bulb.
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance Requirements as follows:

Property	Test Method	Required Limits
Water absorption	ASTM D 570	0.15% max
Tear Resistance	ASTM D 624	200 lb/in (35 kN/m) min.
Ultimate Elongation	ASTM D 638	350% min.
Tensile Strength	ASTM D 638	2000 psi min.
Low Temperature Brittleness	ASTM D 746	No Failure @ -35o F
Stiffness in Flexure	ASTM D 747	600 psi min.
Specific Gravity	ASTM D 792	1.45 max.
Hardness, Shore A	ASTM D 2240	79 +3
Tensile Strength after accelerated extraction	CRD-C 572	1850 psi min.
Elongation after accelerated extraction	CRD-C 572	300% min.
Effect of Alkalis after 7 days: Weight Change Hardness Change	CRD-C 572	between -0.10% / +0.25% +/- 5 points

2.2 CHEMICALLY RESISTANT FLEXIBLE WATERSTOP

- A. Thermoplastic elastomeric rubber waterstops resistant to oil, solvents, and chemicals as manufactured by Westec or approved equal.
- B. Chemical resistance testing to be performed by independent ASTM certified laboratory.
- C. Profile: Ribbed with center bulb
- D. Dimensions: 6 inches by 3/8 inch thick.
- E. Performance requirements as follows:

Property	Test Method	Unexposed Value
Tensile Strength	ASTM D638	2000 psi
Ultimate Elongation	ASTM D638	450%
100% Modulus	ASTM D638	1000 psi
Shore A Hardness	ASTM D2240	85 units
Low Temp Brittleness	ASTM D746	No Failure @ -70 F

- F. Waterstop material should show less than +/- 30% change in material properties, including weight gain after 7-day exposure to selected chemicals, per ASTM D 471 testing.

2.3 HYDROPHILIC WATERSTOP FOR NON-MOVING CONTRACTION AND CONSTRUCTION JOINTS

- A. Provide hydrophilic rubber waterstop as supplied by Greenstreak, HYDROTITE profile style number (fill in profile style number).
- B. The waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
- C. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
- D. Performance Requirements as follows:

Chloroprene Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.

Modified Chloroprene (Hydrophilic) Rubber

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70o F	3 to 1 min.

2.4 ACCESSORIES

- A. PVC and Chemically Resistant Waterstops
1. Provide factory made waterstop fabrications for all changes of direction, intersections, and transitions leaving only straight butt joint splices for the field.
 2. Provide hog rings or grommets spaced at 12 inches on center along length of waterstop.
 3. Provide Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.
 4. Splices to be free from defects.
- B. Hydrophilic Waterstops
1. Provide Greenstreak 7300 two component epoxy gel to secure HYDROTITE to rough, wet (or dry) concrete.

2. Provide LEAKMASTER single component hydrophilic sealant to secure HYDROTITE to rough, dry concrete.
3. Provide cyanacrylate adhesive (super glue) for all splices.
4. Provide LEAKMASTER as addition to cyanacrylate adhesive at all splices for added insurance (Optional).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. PVC and Chemically Resistant Waterstops
 1. Field butt splices shall be heat fused welded using a Teflon covered thermostatically controlled waterstop splicing iron at approximately 380 degrees F. Follow approved manufacturer recommendations.
 2. Lapping of waterstop, use of adhesives, or solvents shall not be allowed.
 3. Center waterstop in joint and secure waterstop in correct position using hog rings or grommets spaced at 12" on centers along the length of the waterstop and wire tie to adjacent reinforcing steel.
 4. Install in longest lengths practicable.
 5. Ensure steel reinforcing bars do not interfere with proper position of waterstop.
 6. Clean concrete joints of dirt and construction debris prior to second pour of concrete.
 7. Cut waterstop ends with miter guide and circular saw to ensure good, full contact at joints.
 8. At expansion joints, keep center bulb unembedded at joint centerline.
- B. Hydrophilic Waterstop
 1. Cut coil ends square (or at proper angle for mitered corners) with shears or sharp blade to fit splices together without overlaps.
 2. Splices shall be sealed using cyanoacrylate adhesive (super glue) and LEAKMASTER (LEAKMASTER is optional).
 3. Seal watertight any exposed cells of HYDROTITE using LEAKMASTER.
 4. Follow approved manufacturer written recommendations.
 5. Install in longest length practicable.
- C. Hydrophilic and PVC Intersections
 1. Maintain continuity of waterstops at all intersections and transitions.
 2. Joinery between PVC and HYDROTITE shall be sealed using LEAKMASTER.
 3. Follow approved manufacturer written recommendations.
- D. Retrofit Waterstop
 1. Prepare existing concrete by grinding away irregularities. Clean concrete to ensure good epoxy bond.
 2. Apply continuous bed of epoxy to concrete 1/8 inch thick.
 3. Embed retrofit waterstop in uncured epoxy.
 4. Mechanically fasten waterstop to concrete using stainless steel batten bars and anchor bolts staggered 6 inches OC max. Use batten bars on top and bottom.
 5. Tool continuous layer of epoxy over batten bars and bolts to protect from corrosion.
 6. Use expansion joint filler at moving joints to minimize shear stresses.

- E. Concrete Placement at Waterstop
 - 1. Carefully place concrete without displacing waterstop from proper position.
 - 2. Thoroughly and systematically vibrate concrete around waterstop to obtain impervious, void free concrete in vicinity of joint and to maximize intimate contact between concrete and waterstop.
 - 3. After first pour, clean un-embedded waterstop leg to ensure full contact of second pour concrete.

END OF SECTION 03 15 13

SECTION 03 20 00 - CONCRETE REINFORCEMENT

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Work Included: Perform all work necessary and required for the construction of the project as indicated. Such work includes but is not necessarily limited to the furnishing and installing of all reinforcing steel for the cast-in-place work and related items necessary to complete the work indicated on the drawings and described in the specifications.
- B. Related Work in Other Section: The following items of associated work are included in other sections of these specifications:
 - 1. Concrete Formwork
 - 2. Cast-In-Place Concrete
 - 3. Anchors and miscellaneous metal items and inserts to be embedded in concrete.
 - 4. Post-Tensioned Concrete

1.2 CODES AND STANDARDS

- A. Except as modified by the requirements specified herein and/or the details on the drawings, all work included in this section shall conform to the applicable provisions of the following codes and standards.
- B. Concrete Reinforcing Steel Institute (CRSI):
 - 1. "Reinforced Concrete - A Manual of Standard Practice"
 - 2. "Recommended Practice for Placing Reinforcing Bars"
 - 3. "Recommended Practice for Placing Bar Supports"
- C. American Concrete Institute (ACI):
 - 1. "Building Code Requirements for Reinforced Concrete", ACI 318
 - 2. "Manual of Standard Practice for Detailing Reinforced Concrete Structures", ACI 315
 - 3. "Specifications for Structural Concrete Buildings", ACI 301
- D. American Society for Testing and Materials (ASTM): The specifications and standards hereinafter referred to latest edition.
- E. Local Ordinances

1.3 SUBMITTALS

- A. Fully detailed shop drawings, including bending schedules and bending diagrams, shall be submitted to the Engineer for approval. Shop drawings shall show placing details and size and location of all reinforcing steel.
- B. Shop drawings shall be of such detail and completeness that all fabrication and placement at the site can be accomplished with the use of the shop drawings. Shop drawings shall include number of pieces, sizes, and markings of reinforcing steel, accessories, and any other information required for fabrication and placement.

- C. Complete shop and placing drawings for all reinforced concrete work shall be drawn to a scale of 1/8" = 1'-0" or larger. Detail wall reinforcement on 1/4" = 1'-0" scale elevations. If so, detailed on structural plans, detail the top and bottom reinforcement on separate plans, each showing all bars, details, accessories, etc., required for proper fabrication and placement of that portion of the reinforcement.
- D. Contractor shall check architectural, structural, mechanical, and electrical project or contract drawings for anchor bolt schedules and location, anchors, inserts, conduits, sleeves, and any other items which are required to be cast in concrete, and shall make necessary provisions as required so that reinforcing steel will not interfere with the placement of such embedded items.
- E. Reinforcing steel shall not be fabricated or placed before the shop drawings have been approved by the Engineer and returned to the Contractor. Approval of shop drawings by the Engineer will not relieve the Contractor of responsibility for errors or for failure in accuracy and complete placing of the work.
- F. Two copies of mill affidavits, stating the grades and physical and chemical properties of the reinforcing steel, shall be submitted to the Engineer before delivery of the steel to the job site.

1.4 PRODUCT HANDLING

- A. Steel reinforcement shall be transported to the building site, stored, and covered in a manner which will ensure that no damage shall occur to it from moisture, dirt, grease, or any other cause that might impair bond to concrete. A sufficient supply of approved reinforcing steel shall be stored on the building site at all times to ensure that there will be no delay of the work. Identification of steel shall be maintained after bundles are broken.

1.5 STORAGE AND PROTECTION

- A. Schedule reinforcement deliveries to minimize on site storage. Where such storage is unavoidable, place the reinforcement on blocks and cover.
- B. Mild steel reinforcement at the time of placement of concrete shall be clean and free of all loose dirt, form oil, and other coatings affecting bond.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcing bars shall be new, deformed billet steel bars, conforming to ASTM A615, Grade 60 (#3 bars may conform to ASTM A615, Grade 40).
- B. Welded wire fabric shall be new, rectangular welded steel wire fabric, conforming to ASTM A185.
- C. Anchoring hardware shall conform to the requirements set forth in the ACI 318 "Standard Building Code for Reinforced Concrete".
- D. Reinforcing steel shall be bundled and tagged with grades and suitable identification marks for checking, sorting, and placing. Tags and markings shall be waterproof and shall not be removed until steel is placed.
- E. Reinforcement accessories, consisting of spacers, chairs, ties, and similar items shall be provided as required for spacing, assembling and supporting reinforcement in place. All accessories shall be of plastic tipped galvanized steel, stainless steel or approved plastic conforming to the applicable requirements of the CRSI Standards hereinbefore specified.

- F. Tie wires for reinforcement shall be 16 gage or heavier, where noted or specified, black or galvanized steel wire conforming to ASTM A82.

2.2 FABRICATION

- A. Fabrication of steel reinforcement shall be in accordance with the details shown on the drawings and approved shop drawings. Where specific details are not shown or noted, comply with the applicable requirements of the "Codes and Standards" hereinbefore specified.
- B. Bars shall be accurately bent, cut, and placed as indicated on the drawings. Bars shall be bent cold; heating of bars will not be permitted. Bars shall not be bent or straightened in any manner that will injure the material.

PART 3 - EXECUTION

3.1 PLACING

- A. Reinforcing steel shall be placed in accordance with the drawings and approved shop drawings and the applicable requirements of the "Codes and Standards" hereinbefore specified. Install reinforcement accurately and secure against movement, particularly under the weight of workmen and the placement of concrete.
- B. Bars shall be supported on chairs or spacers on metal hangers, accurately placed and securely fastened to steel reinforcement in place. Additional bars shall be supplied whether specifically shown on the drawings or not where necessary to securely fasten reinforcement in place. Support legs of accessories in forms without embedding in form surface. Spacing of chairs and accessories shall conform with CRSI's "Recommended Practice for Placing Bar Supports." Hooping and stirrups shall be accurately spaced and wired to the reinforcing. No wood or clay brick will be permitted inside forms.
- C. All reinforcing shall be set in place, spaced, and rigidly and securely tied or wired at all splices and at all crossing points and intersections in the position shown, or as directed. Re-bending of bars on the job to fix existing conditions will not be permitted without the written approval of the Engineer. Point ends on wire ties away from forms.
- D. Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings or, where not shown, the clear spacing shall be 1-1/2 times the bar diameter but in no case less than 1-1/2 inches nor less than 1-1/3 times the maximum size aggregate.
- E. Laps of splices, where shown or noted on drawings, shall be adequate to transfer stress by bond. Unless shown otherwise on drawings, lap bars a minimum of 32 diameters but in no case less than 12 inches. Whenever possible, splices of adjacent bars shall be staggered.
- F. Welded wire fabric shall be in as long lengths as practicable and shall be wired at all laps and splices. Laps shall be ten inches (10"). End laps shall be offset in adjacent widths. Fabric shall be supported at four-foot maximum intervals by chairs or concrete bricks.
- G. Dowels shall be tied securely in place before concrete is deposited. In the event there are no bars in position to which dowels may be tied, No. 3 minimum shall be added to provide proper support and anchorage. Bending of dowels after placement of concrete will not be permitted.
- H. Except where shown otherwise on the drawings, the minimum concrete coverage for steel reinforcement shall be as follows:
 - 1. Where concrete is placed against earth.....3 inches
 - 2. Over column ties.....1-1/2 inches

3. Formed walls.....1-1/2 inches for bars No. 5 and smaller, and 2 inches for bars over No. 5 in size.
4. Suspended slabs.....1 inch for #11 and smaller, 1-1/2 inches for greater than #11.

3.2 NOTIFICATION

- A. Contractor shall notify the Engineer at least 72 hours ahead of each concrete pour, and no concrete shall be placed until all reinforcing steel has been installed by the Contractor and approved by the Engineer.

3.3 CORRECTION DURING CONCRETING

- A. Capable ironworkers shall be kept on the work at all times during the placing of concrete and shall properly reset any reinforcement displaced by runways, workmen or other causes.

3.4 DEFECTIVE WORK

- A. The following reinforcing steel work will be considered defective and may be ordered by the Engineer to be removed and replaced by the Contractor at no additional cost to the Owner.
 1. Bars with kinks or bends not shown on drawings.
 2. Bars injured due to bending or straightening.
 3. Bars heated for bending.
 4. Reinforcement not placed in accordance with the drawings and/or specifications.

END OF SECTION 03 20 00

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete reinforcement, for the following:
1. Footings and/or piers.
 2. Foundation walls.
 3. Slabs-on-grade.
 4. Suspended slabs.
 5. Concrete toppings.
 6. Building frame members.
 7. Building walls.
- B. Related Sections:
1. Section 01 45 23 "Testing and Inspection Services".
 2. Section 03 10 00 "Concrete Forming and Accessories".
 3. Section 03 30 00 "Cast In Place Concrete".
 4. Section 03 47 13 "Tilt Up Concrete".
 5. Section 03 38 16 "Unbonded Post Tensioned Concrete".
 6. Section 04 22 00 "Concrete Unit Masonry".
 7. Section 31 20 00 "Earth Moving".
 8. Section 31 63 29 "Drilled Concrete Piers".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
1. American Concrete Institute (ACI)
 - a. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 - b. ACI 301 – Specifications for Structural Concrete for Buildings
 - c. ACI 315 – Details and Detailing of Concrete Reinforcement
 - d. SP-66 ACI Detailing Manual
 2. American Welding Society (AWS)
 - a. AWS D1.1 – Structural Welding Code
 3. Concrete Reinforcing Steel Institute (CRSI)
 - a. CRSI – Manual of Standard Practice
 - b. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
 - c. CRSI 65 – Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
 4. American Society of Testing Materials (ASTM)

- a. ASTM-A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.
 - b. ASTM-A663: Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties.
 - c. ASTM-A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - d. ASTM-A675: Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
 - e. ASTM-A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - f. ASTM-A775: Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - g. ASTM-A884: Standard Specification for Epoxy-Coated Wire and Welded Wire Reinforcement.
- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement, according to ACI 315 "Details and Detailing of Concrete Reinforcement."
 - 1. Do not reproduce the structural drawings for use as shop drawings.
- C. Bar Supports: Submit manufacturer's product information for bolsters, chairs, spaces, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, installer, and fabricator as indicated herein.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Steel reinforcement and accessories.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Installer Qualifications: An experienced installer who has completed reinforcing installation work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.

- C. Fabricator Qualifications: An experienced fabricator who has completed reinforcing fabrication work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in service performance.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60 or Grade 75 as indicated on Drawings, deformed.
- C. Low-Alloy-Steel Reinforcing Bars for bars to be welded: ASTM A 706, Grade 60 for #6 and smaller bars, Grade 75 for #7 and larger bars, deformed.
- D. Add the following paragraph below for stainless-steel reinforcement. Retain one of two options for reinforcement type.
- E. Stainless-Steel Reinforcing Bars: ASTM A 955, Grade 60, [Type 304] [Type 316L], deformed.
- F. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60 or ASTM A 706, deformed bars, assembled with clips.
- G. Plain-Steel Wire: ASTM A 82, as drawn.
- H. Deformed-Steel Wire: ASTM A 496.
- I. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- J. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or other unacceptable materials.

2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Combined tolerances for formwork, reinforcing fabrication, and reinforcing placement shall not permit a reduction in specified concrete cover of reinforcing steel. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken material. Bars used for concrete reinforcement shall meet following requirements for fabricating tolerances:
 - 1. Sheared length: Plus or minus 1 inch.
 - 2. Depth of truss bars: Plus 0, minus ½ inch.
 - 3. Overall dimensions of stirrups, ties, and spirals: Plus or minus ½ inch.
 - 4. Other bends: Plus or minus 1 inch.
- B. For bars with end bearing splice couplers, bar ends shall terminate in flat surfaces, within 1.5 degrees of a right angle to axis of bars and shall be fitted within 3 degrees of full bearing after assembly.

2.4 DOWEL BAR ANCHORS/SPLICERS

- A. Provide dowel bar anchors and threaded dowels designed to develop, both in tension and compression, 125% of the minimum ASTM specified yield strength of the dowel bars, as evidenced by published I.C.B.O. test reports. Unless otherwise indicated, anchors shall be furnished with ACI standard 90 degree hooks. Dowels shall be furnished by anchor supplier. The following dowel splicing systems are acceptable.
 - 1. Richmond Screw Anchor "Dowel Bar Splicer"
 - 2. Erico "Lenton Form Saver"
 - 3. Dayton Barsplice "Grip-Twist"

2.5 MECHANICAL SPLICES

- A. Provide mechanical splices designed to develop, both in tension and compression, 125% of minimum ASTM yield strength of the smaller bar being coupled, as evidenced by published I.C.B.O. test reports. The following bar splicing systems are acceptable.
 - 1. Erico "Cadweld C-Series"
 - 2. Erico "Lenton"
 - 3. Dayton Barsplice "Bar Grip"

4. Dayton Barsplice "Grip Twist"

2.6 METAL ANCHORAGE AND EMBEDDED METAL ASSEMBLIES

- A. Steel Shapes and Plates: Conform to ASTM A36, "Specification for Structural Steel".
- B. Headed Stud Anchors: Headed studs welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- C. Welding Electrodes: AWS 5.5, Series E70.
- D. Welded Deformed Bar Anchors: Welded by full fusion process, as furnished by TRW Nelson Stud Welding Division.
- E. All metal assemblies exposed to earth, weather, or moisture, including exposure to a crawl space environment, shall be hot dip galvanized.

2.7 FABRICATION OF METAL ACCESSORIES AND EMBEDDED METAL ASSEMBLIES

- A. Fabricate and assemble structural steel items in the shop. Shearing, flame cutting, and chipping shall be done carefully and accurately. Holes shall be cut, drilled, or punched at right angles to the surface of metal and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges. Welded construction shall conform to AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and AWS D1.1. Welding shall be done by AWS certified welders.
- B. Welding of deformed bar anchors and headed stud anchors shall be done by full fusion process equal to that of TRW Nelson Stud Welding Division of KSM Welding Services Division, Omark, Ind. A minimum of two headed studs shall be tested at start of each production period for proper quality control. Studs shall be capable of being bent 45 degrees without weld failure.
- C. Welding of reinforcement shall be done in strict accordance with AWS requirements, using recommended preheat temperature and electrode for type of reinforcement being welded. Bars larger than No. 9 shall not be welded. Welding shall be performed subject to the observance and testing laboratory. Under no circumstances is ordinary reinforcing (ASTM A615) to be welded.
- D. Coatings, where required, shall be applied after fabrication and prior to casting concrete.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.2 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Provide minimum concrete covering for reinforcement as shown in the Structural General Notes.
- G. Place bars to following tolerances:
 1. Clear distance to formed surfaces: Plus or minus 1/4 inch.
 2. Minimum spacing between bars: Minus 1/4 inch.
 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: Plus or minus 1/4 inch.
 - b. Members between 8 and 24 inches deep: Plus or minus 1/2 inch.
 - c. Members more than 24 inches deep: Plus or minus 1 inch.
 4. Crosswise of members: Spaced evenly within 2 inches.
 5. Length of members: Plus or minus 2 inches.
- H. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter, or enough to exceed above tolerances, resulting arrangement of bars subject to approval.
- I. Support reinforcement and fasten together to prevent displacement by construction loads or placing concrete beyond tolerances indicated.
- J. Unless permitted by Engineer, do not bend reinforcement after embedding in hardened concrete.

3.3 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.

- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 21 00 - REINFORCING STEEL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

GENERAL

1.0 DESCRIPTION

This item shall govern for the furnishing and placing of reinforcing steel of the type, size and quantity designated for use in structures, as shown on the plans and in accordance with these specifications.

2.0 MATERIALS

Unless otherwise designated on the plans, or herein, all bar reinforcement shall be deformed and shall conform to the following:

- A. ASTM Designation A615, Grade 40 or 60, open hearth, basic oxygen or electric furnace new billet steel.
Unless noted by these specifications, rail steel or axle steel shall not be permitted. When no specific grade is specified on the plans, the reinforcing steel shall be a minimum Grade 60.

Where bending of bar sizes #14 or #18 of Grade 60 is required, bend testing shall be performed on representative specimens as described for smaller bars in the applicable ASTM Specification. The required bend shall be 90 degrees around a pin having a diameter of 10 times the nominal diameter of the bar.

- B. Spiral reinforcement shall be either smooth or deformed bars or specified herein. Bars for spiral reinforcement shall comply with ASTM Designation A675, A615 or A617. Wire shall conform to ASTM Designation A82. Unless otherwise shown on the plans, the minimum yield strength for spiral reinforcement shall be 40,000 psi. Report of chemical analysis, showing the percentages of carbon, manganese, phosphorus and sulphur will be required of all reinforcing steel bars when it is to be welded.

3.0 BENDING

The reinforcement shall be bent cold, true to the shapes indicated on the plans. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection. Unless otherwise shown on the plans, bends shall be made in accordance with ACI 315.

4.0 FABRICATING TOLERANCES

Fabricating tolerances for bars shall be as indicated in ACI 315.

5.0 STORING

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials.

Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum

dimensions, cross-sectional area and tensile proportions of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

6.0 LAP SPLICES

Splicing of bars, except where shown on the plans, will not be permitted without prior approval of the Engineer. Splices, not provided for on the plans, will be permitted in slabs not more than 15 inches in thickness, columns, walls and parapets subject to the following:

Splices will be permitted in bars 30 feet or less in plan length. For bars exceeding 30 feet in plan length, the distance center to center of splices shall not be less than 30 feet minus one splice length, with no more than one individual bar length less than 10 feet. Splices not shown on the plans, but permitted hereby, shall be made in accordance with Table No. 5. The specified concrete cover shall be maintained at such splices and bars placed in contact and securely tied together. Lap bars so that both bars will be in the same plane parallel to the nearest concrete surface.

Table No. 5
Minimum Lap Requirements

<u>Size #</u>	<u>Grade 40</u>	<u>Grade 60</u>
3	1' - 0"	1' - 0"
4	1' - 2"	1' - 9"
5	1' - 5"	2' - 2"
6	1' - 9"	2' - 7"
7	2' - 4"	3' - 5"
8	3' - 0"	4' - 6"
9	3' - 10"	5' - 8"
10	4' - 10"	7' - 3"
11	5' - 11"	8' - 11"

Spiral steel will be lapped a minimum of one turn. Sizes #14 and #18 may not be lapped.

7.0 WELDED SPLICES

Where shown on the plans or required by the provisions of this item or other pertinent specifications, welded bar splices shall be used. All welding operations, processes, equipment, materials, workmanship and inspection shall conform to the American Welding Society Specification D1.4. For bars #6 and smaller, use lap weld splices with fillet welds equal to one half bar diameter on each side, for 4 inches in length. For bars #7 and larger, use butt weld splices in accordance with AWS D1.4.

All splices whether lap, weld, mechanical or coupler, shall develop the full strength of the bar. Information on mechanical splicing devices and couplers shall be submitted for approval prior to use.

8.0 PLACING

Steel reinforcement shall be placed in the exact position as shown on the plans and held securely in place during the placing of the concrete. The dimensions shown are to centers of bars, unless otherwise noted. Hold bars securely in place with wire and other approved means during placement of concrete.

- A. In plane of steel parallel to nearest surface of concrete, bars should not vary from plan spacing by more than one twelfth of spacing between bars.
- B. In plane of steel perpendicular to nearest surface of concrete, bars shall not vary from plan placement by more than 1/4 inch.

Space steel the required distance from forms or earth by approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers, or approved precast mortar or concrete blocks. For approval of plastic spacers, provide samples of plastic, which show no indications of deterioration after immersion in a 5 percent solution of sodium hydroxide after 120 hours.

Before any concrete is placed, all mortar, mud, dirt, etc., shall be cleaned from reinforcement. No concrete shall be deposited, until the Engineer has inspected the placement of the reinforcing steel and given permission to proceed.

9.0 SUBMITTALS

The following information shall be submitted for reinforcing steel. Six sets of each item shall be submitted.

- A. Product data for all materials used.
- B. Shop drawings indicating locations, placement, sizes and bending. Shop drawings shall be in accordance with the ACI Manual of Practice for Detailing Reinforced Concrete Structures.
- C. When welding is required, furnish report of chemical analysis, showing percentages of carbon, manganese, phosphorus and sulphur.
- D. Submit certified copies of mill certificates of compliance with requirements herein specified.
- E. Submit information on mechanical splicing devices, couplers, and all other reinforcing accessories.

10.0 MEASUREMENT & PAYMENT

Reinforcing steel quantities will not be measured or paid for directly. All costs of furnishing, fabrication, placement, ties, chairs, bending, labor and equipment shall be considered subsidiary to bids for concrete structures, requiring reinforcement.

END OF SECTION 03 21 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Labor, materials, services and equipment required in conjunction with or properly incidental to placing of cast-in-place concrete slabs, building members, and MEP equipment pads as described herein or as shown on the Drawings, including but not limited to:
 - 1. Concrete mix designs.
 - 2. Assistance with Owner provided laboratory testing of concrete.
 - 3. Installation of items to be built-in formwork or embedded in concrete but furnished by other trades, including metal anchors, anchor slots, reglets, hangers, supports, ties, inserts, bolts, corner guards, and sleeves.
 - 4. Cast-in-place concrete, with formwork, under slab vapor barrier, reinforcing, accessories, appurtenances, finishing and curing required to complete concrete work.
 - 5. Grouting under structural steel base plates.
 - 6. Foundation for columns, walls, and slabs on grade.
 - 7. Super-structure for walls, columns, slabs, curbs, stairs, steps, equipment pads, walks, and pre-molded expansions joints.
- B. Examine the drawings for Plumbing, Mechanical, and Electrical work. These subcontractors will furnish and set sleeves or box forms required for openings. Contractor shall use care in placing reinforcement and pouring concrete so as not to displace such sleeves or boxes.
 - 1. All slots, chases, recesses, or openings indicated on the drawings, which are not formed by sleeves or boxes shall be provided in locations shown. When the work of other contractors is completed, the excess part of the openings shall be completely closed with concrete.

1.2 RELATED REQUIREMENTS

- A. Division 1 Sections applicable to the Work of this Section.

1.3 RELATED SECTIONS

- A. Section 01 45 23 - Testing and Inspection Laboratory Services
- B. Section 02 32 00 - Geotechnical Report
- C. Section 31 00 00 - Earthwork
- D. Section 31 62 13.16 - Drilled and Reamed Foundation
- E. Section 32 13 13 - Concrete Paving
- F. Section 07 92 00 - Joint sealants
- G. Electrical and Mechanical Drawings and Specifications for sleeves, conduit, and other items embedded in concrete.

1.4 QUALITY ASSURANCE

- A. Where standards or requirements of this Section conflict with those noted on the Contract Drawings, or the Building Code, the more stringent requirements shall govern. Bring all conflicts and discrepancies to the attention of the Architect and do not start work until such conflicts and discrepancies are clarified and corrected. Failure to do so will not relieve the Contractor from performing the Work correctly at no additional expense to the Owner.
- B. Testing Laboratory Services:
1. Test results shall meet or exceed established standards. A technician from the Owner's Testing Laboratory must be present during all operations.
- C. Evaluation and Acceptance:
1. Codes and Standards: The Work described in this Section, unless otherwise noted on the Drawings, or herein specified, shall be governed by the editions of the following codes or specifications approved by authorities having jurisdiction.
 - a. American Association of State Highway and Transportation Officials (AASHTO)
 - 1) TP 23, "Proposed Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying"
 - b. American Concrete Institute (ACI)
 - 1) 211.1, "Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"
 - 2) 214, "Recommended Practice for Evaluation of Strength Test Results of Concrete"
 - 3) 301, "Specifications for Structural Concrete for Buildings"
 - 4) 302, "Guide for Concrete Floor and Slab Construction"
 - 5) 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"
 - 6) 305, "Hot Weather Concreting"
 - 7) 306, "Cold Weather Concreting"
 - 8) 309, "Standard Practice for Consolidation of Concrete"
 - 9) 311, "ACI Manual of Concrete Inspection"
 - 10) 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures"
 - 11) 318, "Building Code Requirements for Reinforced Concrete"
 - 12) 347, "Recommended Practice for Concrete Formwork"
 - 13) 355.2, "Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary"
 - 14) Keep one copy of "Manual of Concrete Practice" at job site at all times.
 - c. American Society for Testing and Materials (ASTM)
 - 1) A36, Standard Specification for Carbon Structural Steel
 - 2) A108, Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
 - 3) A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 4) A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 5) A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 6) A704, Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
 - 7) C33, Standard Specification for Concrete Aggregate
 - 8) C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

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- 9) C94, Standard Specification for Ready-Mix Concrete
 - 10) C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates
 - 11) C150, Standard Specification for Portland Cement
 - 12) C172, Standard Practice for Sampling Freshly Mixed Concrete
 - 13) C260, Standard Specification for Air-Entraining Admixtures
 - 14) C330, Standard Specification for Lightweight Aggregates for Structural Concrete
 - 15) C494, Standard Specification for Chemical Admixtures for Concrete
 - 16) C595, Standard Specification for Blended Hydraulic Cements
 - 17) C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 18) C979, Standard Specification for Pigments for Integrally Colored Concrete
 - 19) C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
 - 20) C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
 - 21) E96, Standard Test Methods for Water Vapor Transmission of Materials
 - 22) E1643, Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs
 - 23) E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
 - 24) F710, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
- d. American Welding Society (AWS)
- 1) D1.4 Structural Welding Code- Reinforcing Steel
- e. Federal Specification (FS)
- 1) FF-S-325
 - 2) QQ-Z-325C
- f. Concrete Reinforcing Steel Institute (CRSI)
- 1) "Reinforced Concrete – A Manual of Standard Practice"
 - 2) "Recommended Practice for Placing Reinforcing Bars"
 - 3) "Recommended Practice for Placing Bar Supports"

D. Source Quality Control:

- 1. Concrete production facilities shall meet the requirement for certification by the National Ready Mixed Concrete Association. All ready-mix concrete trucks proposed for use on the project shall meet the requirements of NRMCA, Certification of Ready Mix Concrete Production Facilities.
- 2. Concrete batchers shall be completely interlocked semi-automatic or automatic batchers, as defined by the Concrete Plant Manufacturers Bureau.
- 3. Concrete batchers shall have graphic, digital, or photographic recorders, which shall register both empty balance and total weight (or volume of water or admixture) of each batched material, time to the nearest minute, date, identification of batch, and numerical count of each batch. Copies of the record shall be furnished to the Inspection and Testing Laboratory.
- 4. The Inspection and Testing Laboratory shall provide concrete batch plant inspection as follows:
 - a. Provide a qualified inspector with necessary equipment and apparatus to inspect weighing and batching of controlled concrete at batch plant on a random basis, approximately once daily as the concrete is being placed on this project.
 - b. Make certain that materials and batch equipment used are in accordance with requirements of Specifications.

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- c. Check for adjustment in batch weights to compensate for variations in moisture content.
 - d. Submit promptly to Architect, certification of weights used in loads of acceptable concrete which has been batched during plant inspection time.
- E. Concrete Mix Design Criteria:
 - 1. Design concrete mixes in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures.
 - 2. Submit the proposed mix designs for each concrete mix type proposed.
 - 3. Determination of required average strength above specified strength shall be in accordance with ACI 318.
 - 4. If trial mixes are used as the basis for the proposed mix design, mold and cure test cylinders in accordance with ASTM C39. Do not place concrete on project until laboratory reports and results of confirmation cylinder tests have been evaluated by the Inspection and Testing Laboratory and results indicate that proposed mixes will develop required strengths.
 - 5. Inspection and Testing Laboratory shall furnish the Architect with a written evaluation of each proposed concrete mix design submitted by the Contractor.
 - 6. Check mix designs and revise if necessary wherever changes are made in aggregates or in surface water content of aggregate or workability of concrete. Water content shall be minimum to produce workable mix. The water content shall be verified in the field by use of the Microwave Test.

1.5 SUBMITTALS

- A. Mix Designs: Submit proposed mix designs, including confirmation cylinder test results, in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures. Submit mix designs to Architect/Engineer and Inspection and Testing Laboratory for evaluation a minimum of 14 days prior to placing concrete. Key requirements:
 - 1. Combined aggregate gradation.
 - 2. Proportions of cement, fine and coarse aggregates, and water.
 - 3. Type, color and dosage of integral coloring compounds, where applicable.
 - 4. Range of ambient temperature and humidity for which design is valid.
 - 5. Any special characteristics of mix which require precautions in mixing, placing, or finishing techniques to achieve finished product.
- B. Complete test data for trial mixes or a complete summary of previous project test results for mix design based on standard deviation analysis must be included.
- C. Provide duplicate delivery tickets for each load of ready-mix concrete delivered to site, in accordance with ASTM C94. Show batch weights on each ticket.
- D. Provide mill test reports on an as-used basis for each type and brand of cementitious material used.
- E. Provide certification from independent test laboratory indicating under slab vapor retarder compliance with specification and ASTM 1745 Class A requirements.
- F. Provide product data for each accessories item specified but necessarily not listed above which are required for a complete installation, including, but not limited to reinforcing, chairs, admixtures, stains and color pigments, grouts, sealers, vapor retarders and barriers, water stops, epoxy adhesives, curing compounds and anchors.
- G. Provide Shop Drawings for all reinforcing steel. Show bending diagrams, splicing and laps of rods, shapes, dimensions and details of bar reinforcement and accessories.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Mix and deliver concrete to project ready-mixed in accordance with ASTM C94. Mix concrete a minimum of 70 revolutions of transit mix drum at mixing speed. A minimum of 40 revolutions shall be at the production plant.
- B. Schedule delivery so that continuity of any pour will not be interrupted for over 15 minutes.
- C. Place concrete on site within 90 minutes after proportioning materials at batch plant.
- D. Store bagged cement on platforms off ground. Protect stored cement against the elements. Handle and store fine and coarse aggregate separately in manner to prevent intrusion of foreign material or segregation of the material. Protect all reinforcement until used. Do not use any hardened cement.
- E. Mild steel reinforcement at the time of placement of concrete shall be clean and free of all loose dirt, form oil, and other coatings affecting bond.

1.7 JOB CONDITIONS

- A. Hot Weather Concreting:
 - 1. Follow ACI 301 and ACI 305.
 - 2. Provide water-reducing retarding admixture conforming to ASTM C494, Type D when necessary to retard initial set. The admixture shall be dispensed in accordance with manufacturer's recommendations.
 - 3. Maximum concrete temperature shall not exceed 95 degrees F at time of placement.
 - a. Concrete with temperatures above 90 degrees F shall be placed only if a high range water reducer (superplasticizer) is added to the mix as directed by the Testing Laboratory to maintain the specified slump during placement.
- B. Cold Weather Concreting: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures.
 - 1. Follow ACI 301 and ACI 306.
 - 2. When ambient temperature at site is below 40 degrees F or is expected to fall to that temperature within ensuing 24 hours, heat water and/or aggregate prior to adding to mix so that temperature of concrete will be between 55 degrees F and 85 degrees F at time of placement.
 - 3. Maintain temperature of deposited concrete between 50 degrees F and 70 degrees F for minimum of seven (7) days after placing.
 - 4. Add the specified non-corrosive accelerator for all floor concrete placed at air temperatures below 50 degrees F.
- C. Temperature Changes: Maintain changes in concrete temperature as uniformly as possible, but in no case exceed change of 5 degrees F per hour or 25 degrees F in any 24-hour period.
- D. Combustion heaters shall not be used during the first 48 hours without precautions to prevent exposure of concrete and workmen to exhaust gasses containing carbon dioxide and/or carbon monoxide.
- E. Admixtures intended to accelerate hardening of concrete or produce higher than normal strength at early periods will not be permitted unless approved by the Architect. The use of calcium chloride is specifically prohibited.

1.8 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Management and Coordination.

1.9 SEQUENCING/SCHEDULING

- A. Coordinate Work of this Section with work of other Sections as required to properly execute the Work and as necessary to maintain satisfactory progress of the work of other Sections.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- A. Manufacturers named within this Section are approved for use on the Project for the product for which they are specified. Other manufacturers must have a minimum of five (5) years of experience manufacturing the product specified and meet or exceed the specifications for that product. Substitution of products must be in accordance with the General Conditions, Supplementary Conditions, and Section 01 33 00, Submittals to be considered prior to proposal.

2.2 MATERIALS

- A. Formwork:
1. General: Contractor may use any of the following formwork materials as long as material meets the following and will not stain, or impart any undesirable texture, i.e. wood grain, where such texture would be objectionable in an exposed location.
 - a. Wood Forms:
 - 1) Plywood: PS 1, Douglas Fir or Spruce species.
 - 2) Medium Density Overlay (MDO): One (1) side grade; sound undamaged sheets with clean, true edges.
 - 3) Lumber: Southern Yellow Pine species; No. 2 grade, with grade stamp clearly visible.
 - b. Prefabricated Forms:
 - 1) Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - 2) Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - c. Form Liner: Any material recommended by manufacturer to impart finish which will exhibit the finish or design characteristics, i.e. smooth, textured, ribbed, etc. detailed by the Architect for exposed locations as shown or required and capable of being stripped from complex designs without damaging the finish or design. Form liner shall be as manufactured by Symons by Dayton Superior or Architect approved equal.
 - d. Self-expanding corkboard expansion joint fillers should conform to ASTM D1752 for exterior work. Joint fillers shall extend full depth of slab or joint and be of thickness and lengths indicated on drawings.
- B. Metal Reinforcement:
1. Bars:
 - a. General: Conform to ACI 315, latest edition.
 - b. Comply with ASTM A615, Grade 60.
 - c. Number 3 bars comply with ASTM A615, Grade 40
 2. Welded Steel Wire Fabric (Mesh): Not permitted in structural concrete, unless approved by Structural Engineer

- C. Concrete, General:
1. Ready-mixed concrete, ASTM C94
 2. Comply with ACI 318.
 3. Concrete must be approved by Architect through design mix and cylinder test of testing laboratory.
 4. Unless approved otherwise by the Architect, use one (1) brand of cement throughout the work where finished surface will be exposed to view.
 5. Strength: Refer to Paragraph 2.3, A.
- D. Concrete Materials:
1. Cement:
 - a. Portland Cement, Type I or III, conforming to the requirements of ASTM C150.
 - b. Combined aggregate gradation for slabs and other designated concrete shall be 8 percent - 18 percent for large top size aggregates (1-1/2 in.) or 8 percent - 22 percent for smaller top size aggregates (1 in. or 3/4 in.) retained on each sieve below the top size and above the No. 100.
 2. Fly ash: Not permitted.
- E. Aggregate:
1. Fine Aggregate: ASTM C33; clean, hard, durable, uncoated, natural and manufactured sand, free of silt, loam or clay.
 2. Coarse Aggregate: ASTM C33; hard, durable, uncoated, crushed stone; gradation in accordance with Size No. 467 for piers and concrete footings and Size No. 67 for all other concrete. Maximum aggregate size in accordance with ACI 318.
 3. Grading shall be in accordance with "Standard Method for Fine Analysis of Sieve and Coarse Aggregates" (ASTM C136).
- F. Water: ASTM C94, Paragraph 4.1.3; potable, clean and free from oil, acid and injurious amount of vegetable matter, alkalies, and other impurities.
- G. Admixtures:
1. Cement-dispersing, water-reducing types. Admixtures shall conform to ASTM C494, Type A or D, and shall be used strictly in accordance with manufacturer's recommendations and as determined by the Inspection and Testing Laboratory. Admixture shall not discolor concrete or in any way affect the appearance of the concrete.
 - a. High-range water reducing admixture conforming to ASTM C494, Type F or G shall be used as required and shall be one (1) of the following or Architect approved equal:
 - 1) Eucon 37 (Type F), Eucon 537 (Type G) by The Euclid Chemical Company
 - 2) Master Rheobuild 1000 (Type F), Rheobuild 716 (Type G) by BASF Admixtures
 - 3) Sikament 300 (Type F), Sikament 86 (Type G) by Sika Corp.
 - 4) WRDA-19 (Type F), Daracem 100 (Type G) by GCP Applied Technologies
 2. An air-entraining admixture conforming to ASTM C260 shall be used as required on the Drawings and shall be one (1) of the following or Architect approved equal:
 - a. Air-Mix or AEA-92 by The Euclid Chemical Company
 - b. Sika Aer by Sika Corporation
 - c. MB-VR or MB-AE by BASF Admixtures
 3. Prohibited Admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
 4. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Architect/Engineer.

H. Non-Shrink Cement Grout:

1. The non-shrink grout shall be a factory pre-mixed grout and shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 4 foot x 4 foot base plate. Provide one (1) of the following or Architect approved equal:
 - a. NS Grout by The Euclid Chemical Company
 - b. Five Star Grout by U.S. Grout LLC
 - c. Horn Non-Corrosive Non-Shrink Grout by Tamms Industries
 - d. Duragrout by L & M Construction Chemicals, Inc.
 - e. Masterflow 713 by BASF Admixtures
 - f. SikaGrout 212 by Sika Corp.
 - g. SonogROUT 10K by Sonneborn
 - h. 588 Grout by W. R. Meadows, Inc.
 - i. US SPEC GP Grout by US Mix Products Company
2. High Flow Grout: Where high fluidity and/or increased placing time is required, use high flow grout. The factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packages Dry, Hydraulic-Cement Grout (Non-Shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent bearing under a 18 inch x 36 inch base plate. Provide one (1) of the following or Architect approved equal:
 - a. Hi-Flow Grout by The Euclid Chemical Company
 - b. Crystex by L & M Construction Chemicals, Inc.
 - c. Masterflow 928 by BASF Admixtures
 - d. CG-86 Grout by W. R. Meadows, Inc.
 - e. US SPEC MP Grout by US Mix Products Company

I. Non-Oxidizing Metallic Hardener: (For use at Loading Dock where shown)

1. Non-Oxidizing Metallic Floor Hardener: The specified non-oxidizing metallic floor hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specially processed non-rusting aggregate, selected portland cement and necessary plasticizing agents. Product shall be Diamond-Plate by The Euclid Chemical Company or Architect approved equal.

J. Evaporation Retardant:

1. Evaporation Retardant shall be a thin, continuous film which prevents rapid moisture loss from the concrete surface. For use when concrete operations must be performed in direct sun, wind, high temperatures, or for relative humidity. Products: Subject to compliance with requirements, provide one (1) of the following or Architect approved equal:
 - a. Eucobar by The Euclid Chemical Company
 - b. Confilm by BASF Admixtures
 - c. Evapre by W. R. Meadows, Inc.
 - d. US SPEC Monofilm ER by US Mix Products Company.
 - e. E-Con by L& M Construction Chemicals

K. Sealer/Densifier: Provide "Euco Diamond Hard" by The Euclid Chemical Company, "Sealhard" by L&M Construction Chemicals, or equal by Master Builders, Sika Corp., Sonneborn, US SPEC, or Architect approved equal.

L. Chemical Hardener/Dustproofer: Provide "Surfhard" by The Euclid Chemical Company, "Chemhard" by L&M Construction Chemicals, or equal by Master Builders, Sika Corp., Sonneborn, US SPEC, or Architect approved equal.

- M. Curing Compound: dissipating resin type, which chemically breaks down after approximately eight (8) weeks. Membrane forming compound shall meet ASTM C309, Types 1 and 1D Class B, water based, VOC/AIM Compliant. Provide "Kurez DR VOX" by The Euclid Chemical Company, "Cure R" by L&M Construction Chemicals, "1100 Clear" by W. R. Meadows, Inc., US SPEC "Maxcure Resin Clear" by US Mix Products Company, or equal by Master Builders, Sika Corp., BASF, or Architect approved equal.
- N. Curing and Sealing Compound: high solids acrylic copolymer emulsion blend. Membrane forming compound shall meet ASTM C1315, Type 1 Class B. Provide "Super Rez-Seal" by The Euclid Chemical Company, "Dress & Seal" by L&M Construction Chemicals, "VOCOMP 25 1315" by W. R. Meadows, Inc., US SPEC "CS-25-1315" by US Mix Products Company, or equal by Master Builders, Sika Corp., BASF, or Architect approved equal.
- O. Epoxy Adhesive for rebar and threaded rod dowelling: Adhesive anchors shall have been tested and qualified for use in accordance with ICC-ES AC308 for cracked and uncracked concrete recognition. Size and location of anchors shall be as indicated on the drawings. Provide one (1) of the following or Structural approved equal:
1. Simpson Strong-Tie SET-XP (ICC-ES ESR-2508)
 2. Hilti Corp. RE 500-SD (ICC-ES ESR-2322)
 3. Powers Fasteners PE1000+ (ICC-ES ESR-2583)
- P. Epoxy Adhesive to bond fresh concrete to hardened concrete and grout base plates: ASTM C881, two (2) component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces. Provide one (1) of the following or Architect approved equal:
1. Euco #452 Epoxy System or Euco #620 Epoxy System by The Euclid Chemical Company
 2. Sikadur Hi-Mod by Sika Corp.
 3. Rezi-Weld 1000 by W. R. Meadows, Inc.
 4. US SPEC Maxibond 2500 by US Mix Products Company.
 5. Epobond by L& M Construction Chemicals.
- Q. Underslab Vapor Retarders and Barriers:
1. Vapor Retarder Membrane:
 - a. Requirements:
 - 1) Class: ASTM E1745, Class A.
 - 2) Water Vapor Permeance: ASTM E96, 0.015 perms maximum.
 - 3) Tensile Strength: ASTM E154 (Section 9, Average), 45.0 pounds per inch, minimum.
 - 4) Puncture Resistance: ASTM D1709 (Method B), 2400 grams, minimum.
 - b. Provide compatible seam taping and pipe boots or sealing mastic in accordance with manufacturer's requirements.
 - c. Provide proof of compliance to Architect at time of delivery of materials.
 - d. Provide one (1) of the following under entire slab, unless noted otherwise:
 - 1) Barrier Bac-Inc "VB-350"
 - 2) Insulation Solutions, Inc. "Viper II 15 mil"
 - 3) Raven Industries, Inc. "VaporBlock 15"
 - 4) Reef Industries, Inc. "Griffolyn 15 Mil Green"
 - 5) Stego Industries, LLC "Stego-Wrap 15-mil"
 - 6) Tex-Trude, "Xtreme 15 Mil"
 - 7) W. R. Meadows, Inc. "Perminator 15"
 2. Vapor Barrier: Under Wood Floors at Gymnasiums, Stages, and Dance Floors, and at Auditorium Areas Below Finish Floor Level: Premoulded Membrane Vapor Seal with Plasmatic Core manufactured by W.R. Meadows, Inc., Hampshire, IL; or Architect approved equal.

3. Below Grade Waterproofing: Provide below grade waterproofing at vertical walls below grade and beneath elevator pit in accordance with Section 07 16 00.
- R. Miscellaneous Structural Metals Associated with Structural Concrete:
1. Structural steel pieces, including miscellaneous structural metals placed in concrete, exposed to weather, in permanent contact with soil, or accessible to salt intrusion shall be hot dipped galvanized in accordance with ASTM A123.
 2. Structural steel pieces embedded in concrete shall conform to ASTM A36, unless noted otherwise on the Drawings.
 3. Welding of inserts, anchors and other steel pieces used in conjunction with structural concrete shall conform to AWS D1.4.
 4. Welding of reinforcing steel used in conjunction with structural concrete shall conform to AWS D1.4.
 5. Headed stud anchors shall conform to ASTM A108, minimum tensile strength 60,000 PSI.
 6. Mechanical and screw anchors shall have been tested and qualified for use in Accordance with ACI 355.2 and ICC ES AC193 for cracked and uncracked concrete recognition. Size and location shall be as indicated on the Drawings. Provide one (1) of the following or Structural approved equal.
 - a. Simpson Strong-Tie Strong-Bolt wedge anchor (ICC-ES ESR-1771)
 - b. Simpson Strong-Tie Strong-Bolt 2 wedge anchor (ICC-ES ESR-3037)
 - c. Simpson Strong-Tie Titen HD screw anchor (ICC-ES ESR-2713)
 - d. Hilti Corp. Kwik-Bolt TZ wedge anchor (ICC-ES ESR-1917)
 - e. Hilti Corp. Kwik HUS-EZ screw anchor (ICC-ES ESR-3037)
 - f. Hilti Corp. HAD undercut anchor (ICC-ES ESR-1546)
 - g. Powers Fasteners Power-Stud+ SD2 wedge anchor (ICC-ES ESR-2502)
 - h. Powers Fasteners Wedge-Bolt+ screw anchor (ICC-ES ESR-2526)
 - i. Powers Fasteners Atomic+ undercut anchor (ICC-ES ESR-3067)
- S. Miscellaneous Materials and Accessories:
1. Form ties: Adjustable length and type which will not leave holes larger than 1 inch in diameter in face of concrete. Ties shall be such that when forms are removed, no metal will be within 1 inch of the finished concrete surface. The holes must be patched.
 2. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages, Fasteners: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
 3. Form Release Agent: Colorless mineral oil which will not stain concrete or absorb moisture.
 4. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height. Use type with sand cushion pads where concrete is on grade. Provide chairs and spacers Series "B" by W.H.C. Products, Inc., E-Z Chair by Aztec Concrete Accessories, Inc., GTI Bar Chair by General Technologies, Inc., or Architect approved equal.
 5. Waterstops:
 - a. Ribbed flat 3/16 inch by six (6) inch with 1/8 inch ribs, rated for 75 foot of head pressure. Provide factory made corner fittings weld splices with thermostatically controlled heating iron. Style No. 782 by Greenstreak, Inc., or Architect approved equal.
 - b. Contractor's Material Option: Specially formulated preformed joint sealant that provides a lasting,, watertight bond to both fresh and cured concrete surfaces. Synko-Flex Preformed Plastic Adhesive Waterstop and Synko-Flex Primer manufactured by Synko-Flex Products, Division of Henry Company, Houston, Texas; (713) 671-9502 or Architect approved equal.
 6. Carton Void Forms: If shown or required, shall be wax coated corrugated paper material, rectangular in shape and same width as the grade beams, with 1/8-inch thick tempered hardboard for top plane. Provide void forms as required (i.e. with curves, radial) that have vertical supported edges adjacent to all drilled piers, in order to prevent damage to the interior supporting network caused by field cutting.
 7. Soils retainers: If shown or required, shall be composed of lightweight, plastic material that is not adversely affected by moisture. They must be flexible, impact resistant and must be

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- able to resist lateral loads applied by the soils. Retainers shall extend both 6" above and below the top and bottom of void forms.
8. Corners: Chamfer, wood strip type; one (1) inch x one (1) inch size; maximum possible lengths.
 9. Dovetail Anchor Slot: Galvanized steel, 22 gauge thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
 10. Flashing Reglets: Galvanized steel, 22 gauge thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
 11. Bonding Agent: Acrylic latex emulsion type as recommended for bonding new concrete to old concrete.
 12. Integral Color Pigment (If shown or required): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide one (1) of the following or Architect approved equal:
 - a. ChemSystems, Inc.
 - b. Davis Colors
 - c. New Riverside Ochre Co., Inc.
 - d. L.M. Scofield Company
 13. Color Stain (If shown or required): A chemically reactive stain, designed for adding variegated color to new or old concrete. Color(s) shall be as selected by Architect from manufacturer's standard color line. Provide Lithochrome Chemstain by L.M. Scofield Company or Architect approved equal.
 14. Joint Sealants: Refer to Section 07 92 00, Building Sealants

2.3 CONCRETE MIXES

- A. Strength: Concrete is classified and specified by ultimate compressive strength (f c) at the age of 28 days. Unless indicated otherwise on the Drawings, strengths shall be as follows:
 1. All concrete including grade beams, footings, slabs, and pads: 5 sack/3,000 psi/28 days.
 2. Strength recommendations on Structural Drawings supersede when they are greater than specified here.
- B. Interior slabs subjected to vehicular traffic: This concrete shall have a maximum W/cm of 0.48 and maximum air content of 3 percent. No air-entraining admixture shall be added to this mix.
- C. Concrete permanently exposed to freezing and thawing shall conform to Chapter 4 – Durability Requirements of ACI 318. W/cm and air content ratios shall coincide with its respective Exposure Class.
- D. Proportions: Proportions of cement, aggregate, admixture and water to attain required plasticity and compressive strength shall be in accordance with ACI 318, Section 5.3, Proportioning on the basis of field experience and/or trial mixtures. Do not make changes in proportions without submitting proposed changes to Inspection and Testing Laboratory for evaluation.
 1. Trial mixtures having proportions and consistencies suitable for the work shall be made based on ACI 211. 1, using at least three (3) different water-cement ratios which will produce a range of strengths encompassing those required for this project.
 2. Trial mixes shall be designed to produce a slump within 3/4 inch of the maximum permitted, and for air-entrained concrete, within 0.5 percent of maximum allowable air content. The temperature of concrete used in trial batches shall not exceed the maximum temperature specified.
 3. For each water-cement ratio, at least three confirmation compression test cylinders for each test age shall be made and cured in accordance with ASTM C192. Confirmation cylinders shall be tested at seven (7) and 28 days in accordance with ASTM C39.

4. From the results of the 28-day confirmation tests, a curve shall be plotted showing the relationship between the water-cement ratio and compressive strengths. From this curve, the water-cement ratio to be used in the concrete shall be selected to produce the average strength required.
5. The cement content and mixture proportions to be used shall be such that this water-cement ratio is not exceeded when slump is the maximum permitted. Control in the field shall be based upon maintenance of proper cement, water content, slump and air content.
6. Mix designs furnished by the concrete supplier, shall be based on the standard deviation analysis of previous test records meeting the requirements of Section 5.3.1 - Standard deviation of ACI 318. These mixes will be accepted in lieu of trial mixtures described in paragraphs above.
 - a. Temperature of concrete in test data shall be within 5 degrees F of maximum temperature specified for this project.
 - b. Strengths indicated in test data shall be in accordance with ACI 318, Section 5.3.
 - c. The specified strength of concrete used in supporting test data shall vary no more than 500 PSI plus or minus from that specified for this project.
 - d. The Testing Laboratory shall keep a strength and standard deviation record of all concrete for the duration of the project as specified in this section.

PART 3 - EXECUTION

3.1 GENERAL

- A. Inserts: Give the various trades and subcontractors ample notification and opportunity to furnish all anchors, nailers, pipes, conduits, boxes, inserts, thimbles, sleeves, frame vents, wires, supports, or other items required to be built into the concrete by the provisions of the Drawings or of the Specification governing the work of such trades and subcontractors, or as it may be necessary for the proper execution of their work. Obtain suitable templates or instructions for the installation of such items which are required to be placed in the forms.
- B. Install under-slab vapor retarder as instructed by manufacturer in accordance with ASTM E1643. Penetrations shall be sealed to maintain integrity of barrier. Tape around all openings and seal all penetrations as instructed by the barrier manufacturer. Grade stakes shall not be driven through the vapor barrier. Avoid punctures during reinforcement and concrete placement.
- C. Slump:
 1. Concrete not containing a high range water reducing admixture shall not be placed when its plasticity, as measured by slump test, is outside the following limits:
 - a. Footings: 6 inches maximum, 4 inches minimum
 - b. All other Structural Concrete: 5 inches maximum, 3 inches minimum
 - c. Pavement: 4 inches maximum. Coordinate slump with requirements in Section 32 13 13, Concrete Paving.
 - d. Slump drop not to exceed 2 inches when pumped.
 2. Concrete containing a high range water reducing admixture shall not be placed when its plasticity, as measured by slump test, is outside the following limits:
 - a. Prior to addition high range water reducer: 3 inches maximum, 2 inches minimum.
 - b. After addition of high range water reducer: 9 inches maximum.
- D. Classes of Concrete and Usage: Concrete of the several classes of concrete required shall have the characteristics shown on the Drawings.
- E. Mixing:
 1. Transit-mixed concrete conforming to the requirements of ASTM C94 and ACI 304 shall be used in lieu of concrete mixed at the job site. Concrete shall not be transported or used in any case after a period in excess of 90 minutes has elapsed after the introduction of water into the mixer.

2. Indiscriminate addition of water to increase slump of concrete is prohibited. Add water only at the direction of the Testing Laboratory. No water shall be added which increases the water cement ratio of the concrete in excess of the water cement ratio indicated on the approved mix design. At the direction of the Inspection and Testing Laboratory the addition of a high range water reducing admixture may be used to retemper concrete.
 3. The agency supplying transit-mixed concrete shall have a plant of sufficient capacity and adequate transportation facilities, to assure continuous delivery at the rate required. The frequency of deliveries to the site of the work must be such as to provide for placing the concrete continuously throughout any one (1) pour.
- F. Conveying Concrete: Convey concrete from the mixer to the place of final deposit by methods which will prevent the separation or loss of the ingredients. Concrete to be conveyed by pumping shall be submitted to the Inspection and Testing Laboratory for evaluation for each class of concrete specified before being used. Test cylinders for pumped concrete shall be taken at the discharge end of the pumping equipment.
- G. Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to assure a practically continuous flow of concrete at the delivery end without separation of the materials. The use of gravity-flow or aluminum chutes or conveyors for transporting concrete horizontally will not be permitted.
- H. Miscellaneous Materials and Accessories: if not specifically noted, install all materials and accessories per manufacturer's instructions as if noted here in full.
- I. Extend underslab vapor barrier continuously under entire slab, slab turn downs, vertical face of grade beams and footings to completely protect concrete adjacent to earth. Overlap joints and install seam tape and pipe boots, and seal penetrations as instructed by manufacturer.
- J. Bars shall be supported on chairs or spacers on metal hangers, accurately placed and securely fastened to steel reinforcement in place. No wood or clay brick will be permitted inside forms.
- K. All reinforcing shall be set in place, spaced, and rigidly and securely tied or wired at all splices and at all crossing points and intersections.
- L. Minimum center to center distance between parallel bars shall be in accordance with the details on the drawings. Where not shown, the clear spacing shall be 1-1/2 times the bar diameter but never less than 1-1/2 inches.
- M. Lap of splices where shown and noted on the drawings shall be a minimum of 32 bar diameters but never less than 12 inches.
- N. Except where shown on the drawings, minimum concrete coverage for reinforcing steel shall be:
1. 3 inches...where concrete is placed against earth
 2. 1-1/2 inches...over column ties
 3. 1-1/2 inches...for #5 and smaller bars in formed walls
 4. 2 inches...for all bars larger than #5 in formed walls
 5. 1 inch...for #11 and smaller bars in suspended slabs
 6. 1-1/2 inches...for all bars larger than #11 in suspended slabs

3.2 CONCRETE CONTROL AND TESTING

- A. Inspection and Testing laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.
- B. Except as noted below, all inspection and testing related to concrete placement, including reinforcing and embedded items, shall be the responsibility of the Owner. The Owner will directly engage the services of a qualified Testing and Inspection Laboratory, however, the Contractor shall

provide access to the Owner's consultant, and, if required, the Contractor shall provide patching and repairing of surfaces removed to facilitate testing and inspection.

- C. Should the strength of concrete fall below the minimum, then additional tests, including load tests, may be required. These tests, if required, shall be made at the Contractor's expense and shall be in accordance with ASTM C42 and ACI 318. If tests do not meet the applicable requirements, then the structure, or any part of the structure, shall be removed and replaced at the Contractor's expense.
- D. Any concrete testing requested by the Contractor for early formwork or shoring removal, etc., shall be at the Contractor's expense.
- E. Do not permit placement of concrete having a measured slump outside limits given on Drawings or Specifications, except when approved by Architect/Engineer.

3.3 PLACING CONCRETE

- A. Place concrete in reasonably uniform layers, approximately horizontal, and not more than 18 inches deep, exercising care to avoid vertical joints or inclined planes. The piling up of concrete in the forms in such a manner as to cause the separation or loss of any of its ingredients will not be permitted. Concrete which has partially set or hardened shall not, under any circumstances, be deposited in the work. All slabs shall be placed for full thickness in one operation without change in proportions, screeded to proper elevation, and floated. Dusting of surfaces with cement is prohibited.
- B. Place concrete in the forms as nearly in its final position as is practical to avoid re-handling. Exercise special care to prevent splashing the forms or reinforcement with concrete. Remove any hardened or partially hardened concrete which has accumulated on the forms or reinforcement before the work proceeds. Do not place concrete on previously deposited concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the respective member of section, except as hereinafter specified.
- C. Do not permit concrete to drop freely any distance greater than five (5) feet. Where longer drops are necessary, use a chute, tremie, or other acceptable conveyance to assist the concrete into place without separation. Do not pour directly into any excavations where water is standing.
- D. Vibration: As soon as concrete is deposited, thoroughly agitate same by means of mechanical vibrators and suitable hand tools, so manipulated as to work the mixture well into all parts and corners of the forms, and entirely around the reinforcement and inserts. Mechanical vibrators shall maintain frequencies in accordance with the recommendations of ACI 309. Table 5.1.4, and shall be operated by competent workmen. Over vibrating and use of vibrators to transport concrete within forms shall not be allowed. A spare vibrator shall be kept on the job site during all concrete placing operations.
- E. Bonding: Before depositing any new concrete on or against previously deposited concrete which has partially or entirely set, the surface of the latter shall be thoroughly roughened and cleaned of all foreign matter, scum and laitance. The specified or an Architect approved bonding agent or epoxy adhesive shall be used.
- F. Construction Joints: Except as otherwise specifically indicated on the Drawings, each concrete member shall be considered as a single unit of operation, and all concrete for the same shall be placed continuously in order that such unit will be monolithic in construction. Should construction joints prove to be absolutely unavoidable, same shall be located at or near the midpoints of spans. Additional construction joints shall not be made under any circumstances without prior review by the Architect.

Protect all freshly placed concrete from washing by rain, flowing water, etc. Do not allow the concrete to dry out from the time it is deposited in the forms until the expiration of the curing period.

Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all of the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

- G. Cleaning: Upon completion of the work, all forms, equipment, protective coverings and any rubbish resulting therefrom shall be removed from the premises. Finished concrete surfaces shall be left in clean and perfect condition, satisfactory to the Owner. Sweep with an ordinary broom and remove all mortar, concrete droppings, loose dirt, mud, etc.

3.4 FLOOR AND SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
1. After placing slabs, surface shall be leveled to an $F_F 15 - F_L 13$ tolerance. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.
- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, or sand-bed terrazzo, and as otherwise indicated.
1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture. Surface shall achieve an $F_F 20 - F_L 17$ tolerance.
- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final troweling operation, free of trowel marks, uniform in texture and appearance and to a $FF35/ FL30$ tolerance ($FL17$ for elevated slabs). Grind smooth surface defects, which would telegraph through applied floor covering system.
- D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, exterior dugout slabs, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application. A sample panel is required.
- E. Liquid Densifier/Sealer: Apply liquid densifier/sealer on exposed interior floors subject to vehicular abrasion and as indicated on the Drawings. Compound shall be mechanically scrubbed into the surface in strict accordance with the directions of the manufacturer and just prior to completion of construction.

- F. Non-Oxidizing Metallic Floor Hardener: All slabs, in the loading dock area, or other areas noted on the Drawings, shall receive an application of the non-oxidizing, metallic floor hardener applied in accordance with manufacturer's instructions to produce a smooth dense finish.

3.5 NON-SHRINK GROUT

- A. Refer to Structural Drawings for column base plates and other structural grouting requirements.
- B. Non-shrink grout shall be mixed only in such quantities as are needed for immediate use. No re-tempering shall be permitted and materials which have been mixed for a period exceeding 30 minutes shall in no case be used upon any portion of the work.
- C. Where high fluidity and/or increased placing time is required use the specified high flow grout. This grout shall be used for all base plates larger than ten (10) square feet.
- D. For every 1/3 cubic yards of grout placed, grout strength shall be tested with a set of cubes as follows:
 - 1. A set of cubes shall consist of three cubes to be tested seven (7) days, and three (3) cubes to be tested at 28 days.
 - 2. Test cubes shall be made and tested in accordance with ASTM C1107, Section 12.5, with the exception that the grout should be restrained from expansion by a top plate.

3.6 CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. All concrete shall be kept continuously moist and above 50 degrees F for seven days. When high early strength concrete is used this temperature requirement may be lowered to three (3) days.
- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
 - 1. Provide specified curing compound to exposed interior slabs. This curing compound must be dissipating or easily removed in the cleaning process prior to the application of any liquid densifier/ sealer.

3.7 DEFECTIVE WORK

- A. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at the Contractor's expense and shall be in conformity with all of the requirements of the Contract Documents. Removal and replacement of concrete work shall be done in such a manner as not to impair the appearance or strength of the structure in any way.

3.8 CLEANING

- A. Upon completion of the work, all forms, equipment, protective coverings and any rubbish resulting therefrom, shall be removed from the premises. Finished concrete surfaces shall be left in clean and perfect condition, satisfactory to the Owner. Sweep with an ordinary broom and remove all mortar, concrete droppings, loose dirt, mud, etc.

3.9 REPAIR OF DEFECTIVE AREAS

- A. With prior approval of the Architect/Engineer, as to method and procedure, all repairs of defective areas shall conform to ACI 301, Section 5.3.7, using the polymer repair mortars and/or epoxy adhesives furnished by The Euclid Chemical Company, Sika Chemical Corp., or Architect approved equal.

3.10 FIELD QUALITY CONTROL AND TESTING

- A. Inspection and Testing Laboratory services shall be in accordance with Section 01 45 23, Testing and Inspecting Services.

END OF SECTION 03 30 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
 - 6. Building frame members.
 - 7. Building walls.
- B. Related Sections:
 - 1. Section 01 45 23 "Structural Testing and Inspection Services".
 - 2. Section 03 20 00 "Concrete Forming and Accessories".
 - 3. Section 03 10 00 "Concrete Reinforcing".
 - 4. Section 03 11 31 "Void Forms".
 - 5. Section 03 15 13 "Waterstops".
 - 6. Section 03 05 80 "Under-slab Vapor Barrier – Retarder".
 - 7. Section 03 47 13 "Tilt Up Concrete".
 - 8. Section 31 63 29 "Drilled Concrete Piers and Shafts".

1.3 REFERENCES

- A. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. ACI 301 – Specification for Structural Concrete.
 - 2. ACI 302 – Guide for Concrete Floor Slab Construction.
 - 3. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 4. ACI 305 – Hot Weather Concreting.
 - 5. ACI 306 – Cold Weather Concreting.
 - 6. ACI 308 – Guide to Curing Concrete.
 - 7. ACI 309 – Guide for Consolidating Concrete.
 - 8. ACI 311 – ACI Manual for Concrete Inspection.
 - 9. ACI 318 – Building Code Requirements for Reinforced Concrete.
 - 10. ACI 347 – Guide to Concrete Formwork.
 - 11. ACI 207 – Mass Concrete.
 - 12. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

13. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
14. ACI 212.3 – Chemical Admixture for Concrete.
15. ACI 212.4 – Guide for the use of High Range Water Reducing Admixtures in Concrete.
16. ACI 214 – Evaluation of Strength Test Results of Concrete.
17. ACI 303 – Guide to Cast in Place Architectural Concrete Practice.
18. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.

- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture include the following information. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Each proposed mix design shall be accompanied by a complete standard deviation analysis based on at least 30 consecutive strength tests, or by three laboratory trial mixtures with confirmation tests.
 2. Proportions of cement, fine, and coarse aggregate, and water.
 3. Design strength.
 4. Maximum slump.
 5. Air Content.
 6. Maximum water / cement ratio.
 7. Maximum and minimum concrete temperature that is acceptable at time of placement for which the manufacturer can guarantee the strength of the concrete.
 8. Type cement and aggregates.
 9. Type and quantities of all admixtures.
 10. Air dry density and splitting tensile strength for lightweight concrete determined in accordance with ASTM 330.
 11. Type, color, and quantities of integral coloring compounds, where applicable.
 12. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Refer Section 03 20 00.
- D. Formwork Shop Drawings: Refer Section 03 10 00.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Semi rigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: See Section 01 45 23.
 - 1. Contractor's responsibility to testing laboratory.
 - a. Furnish all labor and materials as required to assist testing agency in obtaining, making and handling samples at the jobsite.
 - b. Advise the Owner's Testing Laboratory sufficiently in advance of operations to allow adequate time for the assignment of testing personnel.
 - c. Furnish and maintain adequate facilities for proper curing of concrete test specimens on the project site in accordance with ASTM C31.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings, if any, on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. See Section 03 10 00.

2.2 STEEL REINFORCEMENT

- A. See Section 03 20 00.

2.3 REINFORCEMENT ACCESSORIES

- A. See Section 03 20 00.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C. Carbon content shall not exceed 3 percent by volume.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal as indicated on Drawings for specific uses.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- D. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain not more than 0.05 percent water soluble chloride ions. Do not use calcium chloride or admixtures containing calcium chloride (except the chemical admixture Xypex).
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
 - 7. Waterproofing Admixture: Xypex Admix C-1000
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Hoover Color Corporation.
 - e. Lambert Corporation.
 - f. QC Construction Products.
 - g. Rockwood Pigments NA, Inc.
 - h. Scofield, L. M. Company.
 - i. Solomon Colors, Inc.

2. Color: As selected by Architect from manufacturer's full range.

2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1 to 2-1/4 inches long.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. 3M; Scotchcast Polyolefin Fibers 2".
 - b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
 - c. FORTA Corporation; FORTA FERRO.
 - d. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
 - e. Nycon, Inc.; XL.
 - f. Propex Concrete Systems Corp.; Fibermesh 650.
 - g. Sika Corporation; Sika Fiber MS or MS10.

2.7 CONCRETE MIX DESIGNS

- A. Selection of Proportions: Proportions of ingredients for concrete mixes shall be determined by a qualified concrete supplier in accordance with the requirements of ACI 301.
- B. Required average strength above specified strength: Determination of required average strength above specified strength shall be based on the standard deviation record of the production facility in accordance with ACI 301. Calculation of standard deviation of compressive strength results shall be made in accordance with ACI 214. If a suitable record of strength tests is not available, proportions shall be selected on the basis of laboratory trial batches to produce an average strength greater than the strength f'_c by the amount defined in ACI 301.

2.8 VAPOR RETARDERS

- A. See Section 03 05 80.

2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, non-glazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
 - c. Lambert Corporation; EMAG-20.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; A-H Aloxx.
 - b. L&M Construction Chemicals, Inc.; Grip It AO.

- c. Master Builders Solutions; MasterTop 120SR (Pre-2014: Frictex NS)

2.10 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. Conspec by Dayton Superior; Intraseal.
 - d. Curecrete Distribution Inc.; Ashford Formula.
 - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - f. Edoco by Dayton Superior; Titan Hard.
 - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - h. Kaufman Products, Inc.; SureHard.
 - i. L&M Construction Chemicals, Inc.; Seal Hard.
 - j. Meadows, W. R., Inc.; LIQUI-HARD.
 - k. Metalcrete Industries; Floorsaver.
 - l. Nox-Crete Products Group; Duro-Nox.
 - m. Symons by Dayton Superior; Buff Hard.
 - n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
 - o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. ChemMasters; SprayFilm.
 - c. Conspec by Dayton Superior; Aquafilm.
 - d. Dayton Superior Corporation; Sure Film (J-74).
 - e. Edoco by Dayton Superior; BurkeFilm.
 - f. Euclid Chemical Company (The), an RPM company; Eucobar.
 - g. Kaufman Products, Inc.; Vapor-Aid.
 - h. Lambert Corporation; LAMBCO Skin.

- i. L&M Construction Chemicals, Inc.; E-CON.
 - j. Master Builders Solutions; MasterKure ER 50 (Pre-2014: Conflim).
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; W.B. Resin Cure.
 - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - e. Edoco by Dayton Superior; Res X Cure WB.
 - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - g. Kaufman Products, Inc.; Thinfil 420.
 - h. Lambert Corporation; AQUA KURE - CLEAR.
 - i. L&M Construction Chemicals, Inc.; L&M Cure R.
 - j. Meadows, W. R., Inc.; 1100-CLEAR.
 - k. Nox-Crete Products Group; Resin Cure E.
 - l. Right Pointe; Clear Water Resin.
 - m. SpecChem, LLC; Spec Rez Clear.
 - n. Symons by Dayton Superior; Resi-Chem Clear.
 - o. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - p. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemMasters; Polyseal WB.
 - b. Conspec by Dayton Superior; Sealcure 1315 WB.
 - c. Edoco by Dayton Superior; Cureseal 1315 WB.
 - d. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - e. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - f. Lambert Corporation; UV Safe Seal.
 - g. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.

- h. Master Builders Solutions; MasterKure CC 1315WB (Pre 2014: Kure1315).
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.
 - l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 RELATED MATERIALS

- A. Expansion and Isolation Joint Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, as indicated in Structural General Notes.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 NON-SHRINK GROUT

- A. Grout shall be prepackaged, non metallic, and non gaseous. It shall be non-shrink when tested in accordance with ASTM-C1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds. Thirty-minute-old grout shall flow through the flow cone after slight agitation, in temperatures of 40 degrees to 90 degrees Fahrenheit. Grout shall be bleed free and attain 7,500 psi compressive strength in 28 days at fluid consistency. Certified independent test data required. Approved products include the following:
 - 1. "Euco NS" by Euclid Chemical Company
 - 2. "Masterflow 713" by Master Builders.

2.16 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixture as indicated in Structural General Notes:

2.17 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.18 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. See Section 03 10 00.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. See Section 03 10 00.

3.4 SHORES AND RESHORES

- A. See Section 03 10 00.

3.5 VAPOR RETARDERS/BARRIERS

- A. See Section 03 05 80.

3.6 STEEL REINFORCEMENT

- A. See Section 03 20 00

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are specified or otherwise indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Do not permit concrete to drop freely any distance greater than 10'-0" for concrete containing a high range water reducing admixture or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- H. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. See Section 03 10 00.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and/or to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated and/or to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and/or exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces according to ASTM E 1155, for a randomly trafficked floor surface.

- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated or where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 - 2. After broadcasting and tamping, apply float finish.
 - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive granules.

3.11 CONCRETE FLOOR FINISH TOLERANCES

- A. Interior Finish Floor surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155, "Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System." The following values apply before removal of shores. Levelness values F(L) do not apply to intentionally sloped or cambered areas, nor to slabs poured on metal deck or precast concrete.
 - 1. Exposed, vinyl tiled, or thin-set tiled floors: Specified overall values of flatness, Ff =35; and levelness, FI =25; with minimum local values of flatness, Ff =24; and levelness, FI =17.
 - 2. Carpeted floors, floors under concrete toppings, thickset tile and terrazzo: Specified overall values of flatness, Ff =25; and levelness, FI = 20; with minimum local values of flatness, Ff =17; and levelness, FI =15.
- B. Floor Elevation Tolerance Envelope:
 - 1. The acceptable tolerance envelope for absolute elevation of any point on the slab surface, with respect to the elevation shown on the Drawings, is as follows:
 - a. Slab-on-Grade, or Slab-on-Void Construction: +/- 3/4"
 - b. Top surfaces of formed slabs measured prior to removal of supporting shores: +/- 3/4"
 - c. Top surfaces of all other slabs: +/- 3/4"
 - d. Slabs specified to slope shall have a tolerance from the specified slope of 3/8" in 10'-0" at any point, up to 3/4" from theoretical elevation at any point.

3.12 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-

place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

- b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 28 days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 4. Control and dispose of waste products produced by grinding and polishing operations.
 5. Neutralize and clean polished floor surfaces.
- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: See Section 01 45 23.
1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

NOTE: Add articles for flowable fill in products and execution. NEEDS RESEARCH.

END OF SECTION 03 30 00

SECTION 03 35 00 - CONCRETE FINISHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Surface treatments for concrete floors and slabs.
 - 2. Liquid densifiers and hardeners.
 - 3. Dry shake hardeners.
 - 4. Concrete stains and dyes.
 - 5. Clear coatings.
- B. Related Sections
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.3 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 301 - Specifications for Concrete Construction (ACI 301-20); 2020 Edition, September 2020.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.
- D. ACI 305R - Guide to Hot Weather Concreting; September 2020.
- E. ACI 306R - Guide to Cold Weather Concreting; 2016 Edition, September 2016.
- F. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); 2019 Edition, June 2019.
- G. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials-Guide; 2023.
- H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.
- D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- E. Specimen Warranty: Manufacturer warranty.

1.6 QUALITY ASSURANCE

- A. For slabs indicated to receive concrete polishing system, do not proceed with concrete polishing unless manufacturer's representative and specialized equipment is present for every day of placement.

1.7 MOCK-UP

- A. Mockup required for review by Owner/ Architect.
- B. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- C. Mock-Up Size: 8 foot square.
- D. Locate where directed by the Architect.
- E. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.9 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.10 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Euclid Chemical Company: www.euclidchemical.com.
 - 2. Forta Corporation: www.forta-ferro.com.
 - 3. Penetron: www.penetron.com.
 - 4. PROSOCO, Inc.: www.prosoco.com.
 - 5. Solomon Colors: www.solomoncolors.com.
 - 6. TK Products Construction Coatings: www.surecretedesign.com.
 - 7. W.R. Meadows: www.wrmeadows.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Americans with Disabilities Act of 1990, as amended:
 - 1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
 - 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 3. Concrete Standards:
 - a. American Concrete Institute (ACI) Publications: (Standards):
 - 1) Comply with the following unless modified by requirements in the Contract Documents:

- (a) ACI 117, "Specification for Tolerances for Concrete Construction and Materials and Commentary."
- (b) ACI 301, "Specifications for Structural Concrete."
- (c) ACI 302.1R, "Guide to Concrete Floor and Slab Construction."
- (d) ACI PRC-302.2, "Guide for Concrete Slabs that receive Moisture-Sensitive Flooring Materials."
- (e) ACI 305R, "Guide to Hot Weather Concreting."
- (f) ACI 306R, "Guide to Cold Weather Concreting."
- (g) ACI 318, "Building Code Requirements for Structural Concrete and Commentary."

2.3 CONCRETE FLOOR FINISH APPLICATIONS

- A. Typical Concrete Finishing:
 - 1. Unless otherwise indicated, all exposed concrete floors are to be finished using trowling air, densifier, and hardener, liquid densifier and hardener, dry shake hardener, slip-resistant coating, concrete stain or dye, high-gloss clear coating, and low-gloss clear coating.

2.4 SURFACE TREATMENTS

- A. Troweling Aid, Densifier and Curing Agent: Liquid reactive colloidal silica-based topical treatment, spray-applied to wet concrete and floated or troweled into the surface.
 - 1. Basis of Design Product:
 - a. EXTEND-PRO manufactured by Forta Corporation.
 - b. Peneseal FH-PS manufactured by Penetron.
 - c. Solomon Colors Lythic Day1 manufactured by Solomon Colors.

2.5 DENSIFIERS AND HARDENERS

- A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores, hardening, and dustproofing.
- B. Dry Shake Hardener: Premixed dry powder for spreading on and working into concrete surface prior to set.

2.6 COATINGS

- A. Slip-Resistant Coating: Pre-mixed blend of Portland cement, hardeners and emery/corundum.
 - 1. Basis of Design Product:
- B. Concrete Stain or Dye: Translucent, penetrating compound for interior or exterior use; finished with a topical sealer.
 - 1. Number of Coats: Minimum of two.
 - 2. VOC: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 3. Primary Color: _____, in a formulation to match approved mock-up.
 - 4. Application:
 - a. Primary Color: Spray applied.
- C. High-Gloss Clear Coating: Transparent, non-yellowing, acrylic polymer-based coating.
- D. Low-Gloss Clear Coating: Transparent, non-yellowing, acrylic polymer-based coating.

2.7 AGGREGATES

- A. Plastic Aggregate: Finely ground polymer for addition to coatings for slip resistance.
 - 1. Basis of Design Product:
- B. Natural Aggregate: Finely ground stone for addition to coatings for slip resistance.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.2 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.3 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION 03 35 00

SECTION 03 35 10.2 – SAND BLAST FINISH CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: Materials, processes, and application techniques for a sandblasted concrete finish utilizing stencils, applicable to both horizontal and vertical surfaces
- B. Related Sections: Refer to the following sections for related work

Section 02200: "Earthwork"

Section 03300: "Cast-In-Place Concrete"

Section 05500: "Metal Fabrications"

Section: 07900: "Joint Sealants"

1.2 REFERENCES

- A. ASTM C42-Standard Tet Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- B. ASTM D4258-Standard Practice for Surface Cleaning Concrete for Coating.

1.3 SUBMITTALS

- A. General: Submit the following items in accordance with the Conditions of Contract and Section 01330, "Submittal Procedures".
- B. Product Data: Submit product data for the following materials and items.
 - a. Sandblasting Media
 - b. Stencils
 - c. Sealers
 - d. Contractor relevant experience
- C. Provide mock-up to confirm acceptable tolerances before proceeding with work.

1.4 QUALITY ASSURANCE

- A. Contractor shall have a minimum of five years' experience with sandblasted concrete finishes or stone.
- B. Mock-up Panels: Confirm size prior to mock-up size will vary dependent on graphic, depth, and application. Landscape Architect to provide final approval.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Concrete Mix
 - a. To the required specifications as per the project requirements.
- B. Sandblasting Media
 - a. Silica Sand or other appropriate blasting media, free of contaminants.
- C. Stencils
 - a. Custom or standard stencils made of a durable, adhesive material suitable for the sandblasting process.
 - 1. Landscape Architect or owner to provide vector file for contractor to fabricate stencil
- D. Sealer
 - a. Clear, penetrating sealer to protect the finished surface

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive sandblasted finish, ensuring they are free of defects.
- B. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Clean surfaces in accordance with ASTM D4258
- B. Apply stencils as per design pattern, ensuring secure attachment and proper alignment.

3.3 SANDBLASTING

- A. Performed by Blast Incorporated, Houston, TX. Contact Daniel Moritz 713.623.3315. or approved equal.
- B. Sandblasting shall be performed by skilled technicians using equipment specifically designed for the task.
- C. Maintain a consistent blasting distance, angle, and pressure to achieve the desired texture.
- D. Medium Cut: Approximately one-sixteenth inch to one-eighth inch depth.
- E. Blast corners and edge of patterns carefully, using back-up boards, in order to maintain a uniform corner of edge line.
- F. Use same nozzle, nozzle pressure and blasting technique as used for sample panel.
- G. Protect surrounding areas and features to prevent unnecessary damage.
- H. Proceed in a systematic manner, working in manageable sections.

3.4 CLEANING

- A. Thoroughly clean the surface to remove all residual sandblasting media
- B. Inspect for any imperfections and correct as necessary.
- C. Confirm a consistent depth for all text or graphics

3.5 SEALING

- A. Apply sealer or stain according to manufacturer's instructions, ensuring an even coat for protection.

3.6 FINAL INSPECTION

- A. Arrange for inspection by Landscape Architect to confirm that the work conforms to specified requirements.

3.7 MAINTENANCE

- A. Provide the owner with maintenance instructions for the sandblasted concrete finish.

END OF SECTION 03 35 10.2

SECTION 03 35 19 - INTEGRALLY COLORED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Integrally colored finishes for site-cast concrete.
 - 2. If this Section conflicts with Related Sections:
 - a. This Section takes precedence for matters that affect concrete appearance.
 - b. Related Sections take precedence for matters that do not affect concrete appearance.
 - c. In case of conflicts, notify Landscape Architect for clarification.

1.2 REFERENCE STANDARDS

- A. ACI 301 – Structural Concrete.
- B. ACI 303.1 – Cast-in-Place Architectural Concrete.
- C. ACI 305.1 – Hot Weather Concreting.
- D. ACI 306.1 – Cold Weather Concreting.
- E. ACI 308R – Curing Concrete.
- F. ACI 318 – Building Code Requirements for Structural Concrete.
- G. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
- H. ASTM C979 – Pigments for Integrally Colored Concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:
 - 1. Conduct conference at Project site.
 - 2. Comply with Division 01 Section "Project Management and Coordination"
 - 3. Review procedures required to produce specified results.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Color additives.
 - 2. Curing products.
 - 3. Form release agents.
 - 4. Proprietary cleaning agents.
 - 5. Surface retarders.
- B. Shop Drawings: Indicate extent of each color of integrally colored concrete.
- C. Samples for Initial Selection: Submit color additive manufacturer's sample chip set.
- D. Samples for Verification: Submit sample chip of specified concrete colors indicating color name.
- E. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with: ACI 301, ACI 305.1, ACI 306.1, ACI 318.
- B. Obtain each material from same source and maintain high degree of consistency in workmanship throughout Project.
- C. Installer Qualifications: Concrete work shall be by firm with five years experience with work of similar scope and quality.
- D. Field Samples: Submit three samples 60 by 60 inches indicating concrete color range and texture.
- E. Integrally Colored Concrete Mock-Up:
 - 1. Provide full-scale mock-up under Division 01 Section "Quality Requirements" Construct at least one month before start of other concrete work to allow concrete to cure before observation.
 - 2. At location acceptable to Architect, demonstrate methods used for construction, including forming and finishing conditions required for Project using materials, workmanship, joint treatments, form ties, patching techniques, and curing methods to be used throughout Project.
 - 3. Accepted mock-up provides visual standard for work of Section.
 - 4. Remove mock-up when no longer required for comparison with finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Color Additive: Deliver, store, and handle in accordance with manufacturer's instructions.
- B. Concrete: Schedule delivery to provide consistent mix times from time color additive is placed in mixture until placement of integrally colored concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cements:
 - 1. Types: As specified in Related Sections.
 - 2. Colors: As required to match Reference Sample.
- B. Supplementary Cementitious Materials:
 - 1. Types: As specified in Related Sections.
 - 2. Colors: As required to match Reference Sample.
- C. Fine Aggregate:
 - 1. Types: As specified in Related Sections.
 - 2. Color: As required to match Reference Sample.
- D. Coarse Aggregate:
 - 1. Types: As specified in Related Sections.
 - 2. Color: As required to match approved concrete sample.
- E. Water: Clean and potable.
- F. Admixtures: Do not use calcium chloride admixtures.

2.2 COLOR ADDITIVES

A. Manufacturer:

1. Butterfield Color
Contact Information:
 - a. Phone: 800-282-3388
 - b. E-mail: decorativeconcrete.orders@us.sika.com
 - c. Web Site: www.butterfieldcolor.com.
2. L.M. Scofield Company, Chromix
 - a. Phone: 770-920-600
3. Sika USA
 - a. Phone: (800) 800-9900 or the appropriate local contact

B. Type:

1. Concentrated pigments specially processed for mixing into concrete and complying with ASTM C979.

C. Color Additive Delivery:

1. Automated Dispensing: Meter and dispense colors using computer-controlled automated color weighing and dispensing system. Use Butterfield Color Uni-Mix Liquid Dispensing System.

2.3 FORMED CONCRETE

A. Forms and Form Facing Materials:

1. Type: High density and non-vapor transmitting form face, free of rust or other defects deleterious to required finish, and with watertight joints.

B. Form Ties: Corrosion-resistant ties, removable cones, and plugs.

C. Form Release: Use type that is non-staining and minimizes formation of bug-holes.

D. Curing Compound for Formed Surfaces: Complying with ASTM C309 and approved by color additive manufacturer for use on integrally colored concrete. Do not use white-pigmented curing compounds.

2.4 ACCESSORIES

A. Reinforcing Bar Supports: Use corrosion-resistant types at locations contacting exposed surfaces.

B. Joint Sealants:

1. Provide type specified in Division 07 Section "Joint Sealants"
2. Color: Color selected by [Architect from manufacturer's full range to match integrally colored concrete.

C. Cleaning Agents: Use products recommended by manufacturer's specification.

2.5 MIXES

A. Slump: If greater slump is required, use water-reducing or super-plasticizing admixture; do not add water.

B. Color Additives: Mix in accordance with manufacturer's instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated.

- C. Do not retemper mix or add water in field.

2.6 CONCRETE COLORS

- A. Concrete Colors: Provide color additives that, along with specified concrete materials, result in concrete to match.
- B. Concrete Colors:
 - 1. Provide colors to be selected by Landscape Architect from manufacturer's full range of colors. Reference drawings for selected colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not place integrally colored concrete where standing water is present.

3.2 INSTALLATION

- A. Comply with color admixture manufacturer's recommendations unless otherwise specified in this Section.

3.3 FORMED SURFACES

- A. Concrete Paving:
 - 1. Meet requirements outlined in 32 13 13 – 4 of the Project Manual.
 - 2. Reference Plans for Colored Concrete Location and Condition/Surface Finish.
 - 3. Match sample finish. Contractor must reproduce a mockup of the sample finish on an area at least 25 square feet.
- B. Curing and Stripping:
 - 1. Curing: Cure for 28 days. Maintain concrete between [65° and 85°F] during curing.
 - 2. Leave forms in place for as long as practical, and do not strip until concrete has reached a consistent age.
 - 3. Stripping: If forms are removed before required curing duration, apply curing compound for formed surfaces. To extent practical, integrally colored concrete throughout project should be cured using the same methods and for the same durations.
 - 4. Do not cover concrete with plastic sheeting.
- C. Repair:
 - 1. Fill holes and defects in concrete surface within 48 hours of form removal.
 - 2. Use patching materials and techniques approved in mock-up.
 - 3. Make patches with stiff mortar made with materials from same sources as concrete. Adjust mortar mix proportions so dry patch matches dry adjacent concrete. Add white cement to mortar mix if necessary to lighten it. With exposed aggregate finishes, add aggregate to mortar mix so patches will have same texture and appearance as adjacent concrete.

3.4 APPEARANCE TOLERANCES

- A. Appearance: Minor variations in appearance of integrally colored concrete that are similar to natural variations in color and appearance of uncolored concrete are acceptable.

3.5 CLEANING

- A. Efflorescence: Remove efflorescence as soon as practical after it appears.
- B. Use least aggressive cleaning techniques possible.
- C. If proprietary cleaning agents are used, pre-wet surface, test cleaning agent on small, inconspicuous area, and check effects prior to proceeding. At walls, begin cleaning at top and work down. Thoroughly rinse surface afterwards with clean water. Follow cleaner manufacturer's instructions.
- D. Do not use muriatic or hydrochloric acid on integrally colored concrete.

END OF SECTION 03 35 19

SECTION 03 35 43 - POLISHED CONCRETE FINISHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Polished concrete floor finish for new full-depth slab-on-grade.
 - 2. Polished concrete floor finish for topping.
 - 3. Staining.
 - 4. Scoring.
 - 5. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 22 00 - Unit Prices: Cost per unit of area for polishing concrete.
 - 2. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
 - 3. Section 03 30 00 - Cast-in-Place Concrete.

1.3 ABBREVIATIONS AND ACRONYMS

- A. CPC: Concrete Polishing Council.

1.4 REFERENCE STANDARDS

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010.
- C. ACI 301 - Specifications for Concrete Construction (ACI 301-20); 2020 Edition, September 2020.
- D. ACI 301 - Specifications for Concrete Construction; 2020.
- E. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2015.
- F. ACI 302.1R - Guide to Concrete Floor and Slab Construction; 2015.
- G. ACI 305R - Guide to Hot Weather Concreting; September 2020.
- H. ACI 306R - Guide to Cold Weather Concreting; 2016 Edition, September 2016.
- I. ACI 318 - Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete (ACI 318R-19); 2019 Edition, June 2019.
- J. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- K. ACI PRC-302.2 - Concrete Slabs that Receive Moisture-Sensitive Flooring Materials-Guide; 2023.
- L. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.
- M. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- N. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2019, with Editorial Revision (2020).
- O. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- P. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

- Q. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- R. ASTM C156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete; 2020.
- S. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.
- T. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- U. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces; 2009 (Reapproved 2023).
- V. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).
- W. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces; 2018 (Reapproved 2023).
- X. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.
- Y. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.
- Z. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- AA. CRSI (DA4) - Manual of Standard Practice; 2023.
- BB. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- CC. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting 15 days prior to start of work of this section.
 - 1. Review project conditions, manufacturer requirements, delivery and storage, staging and sequencing, and protection and coordination with other work.
 - 2. Require attendance of parties directly affecting work of this section, including:
 - a. Installer.
 - b. Contractor's representative.
- B. Notify the Architect and manufacturer of concrete placement schedule prior to commencement of placement operations.
- C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

1.6 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.
- D. Verification Samples: Submit 6- by 6-inch (152 by 152 mm) sample chips of specified colors and finishes indicating pigment numbers and required dosage rates for subsequent comparison to installed concrete.

- E. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
- F. Manufacturer's Qualification Statement: Submit five projects of similar size and complexity as references.
- G. Executed warranty.

1.7 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.
- B. Mock-Ups
 - 1. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
 - 2. Accepted mock-up panel is considered basis of quality for finished work. Maintain mix design consistent with mock-up panel for duration of concrete work. Keep mock-up exposed to view for duration of concrete work.
 - 3. Mock-up may remain as part of work.
- C. Pre-Installation Conference
 - 1. Conduct conference at site.
 - 2. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Polished concrete finishing subcontractor.
 - 3. Review cold and hot weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original containers, with seals unbroken, bearing manufacturer labels indicating brand name and directions for storage.
- B. Dispense special concrete finish material from factory numbered and sealed containers. Maintain record of container numbers.

1.9 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic necessary for other construction activities.
- B. Environmental limitations:
 - 1. Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and conditions affecting topping performance.
 - 2. Concrete Flatness:
 - a. Floor Flatness Rating: Minimum FF40.
 - b. Floor Levelness Rating: Minimum FL 40.
 - 3. Curing: Minimum of 28 days or as directed by the manufacturer before application.
 - 4. Apply stain minimum 10 days prior to installation of equipment and substantial completion, ensuring uninhibited concrete slab.
 - 5. Close areas to traffic during floor application and after application, for time period recommended in writing by manufacturer.

1.10 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 20-year manufacturer warranty against installation defects and material performance; ensure forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Euclid Chemical Company, a RPM Company: www.euclidchemical.com.
 - 2. Laticrete: www.laticrete.com.
 - 3. PROSOCO, Inc: www.prosoco.com/consolideck.
 - 4. Solomon Colors: www.solomoncolors.com.
 - 5. W.R. Meadows, Inc: www.wrmeadows.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Accessibility:
 - a. Texas Accessibility Standards (TAS).
 - 2. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 3. Concrete Standards:
 - a. American Concrete Institute (ACI) Publications: (Standards):
 - 1) Comply with the following unless modified by requirements in the Contract Documents:
 - (a) ACI 117, "Specification for Tolerances for Concrete Construction and Materials and Commentary."
 - (b) ACI 301, "Specifications for Structural Concrete."
 - (c) ACI 302.1R, "Guide to Concrete Floor and Slab Construction."
 - (d) ACI PRC-302.2, "Guide for Concrete Slabs that receive Moisture-Sensitive Flooring Materials."
 - (e) ACI 305R, "Guide to Hot Weather Concreting."
 - (f) ACI 306R, "Guide to Cold Weather Concreting."
 - (g) ACI 318, "Building Code Requirements for Structural Concrete and Commentary."

2.3 BASIS OF DESIGN SYSTEM

- A. Double Diamond Polished Concrete Floor Systems by Euclid Chemical Company.

2.4 MATERIALS

- A. Densifying and Sealing Treatment.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Liqui-Hard manufactured by W.R. Meadows.
- B. Penetrating Liquid Floor Treatments for Polished Concrete Finish:

1. Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Products manufactured by Euclid Chemical Company (The); an RPM company.

2.5 POLISHED CONCRETE FLOOR FINISH FOR CONCRETE

- A. Formwork:
 1. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.
 2. Form Materials: As recommended by manufacturer.
- B. Reinforcement:
 1. Reinforcing Bars: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa), Class A epoxy-coated deformed billet-steel bars.
 2. Welded Wire Reinforcement (WWR): Class A epoxy-coated, deformed type, ASTM A884/A884M, flat sheets.
- C. Concrete Materials: Approved by polished concrete manufacturer.
 1. Water: ASTM C1602/C1602M, clean, potable, and not detrimental to concrete.
 2. Cement: ASTM C150/C150M, Type I - Normal portland type; use cement from same source for entire project.
 3. Fine and Coarse Aggregates: ASTM C33/C33M, manufacturer-sourced colored aggregate.

2.6 POLISHED CONCRETE FLOOR TOPPING OVER ANOTHER FLOOR

- A. Concrete Materials: Approved by polished concrete manufacturer.
 1. Water: ASTM C1602/C1602M, clean, potable, and not detrimental to concrete.
 2. Cement: ASTM C150/C150M, Type I - Normal portland type; use cement from the same source for the entire project.
 3. Fine and Coarse Aggregates: ASTM C33/C33M, manufacturer-sourced colored aggregate.
 4. Densifier: Odorless, nonfilm-forming, penetrating colloidal silica solution.
 5. Sealer: Film-forming, stain-resistant, food-resistant, water-repellent impregnating sealer.
 6. Grout: Resinous, high gloss, high clarity final surface.
 7. Surface Repair: Polishable, three-component, moisture-resistant, fast-curing, resinous cement color-matching repair system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.
- B. Examine substrate for conditions affecting performance of finish. Correct conditions detrimental to timely and proper work:
 1. Verify that slab complies with finish and surface profile requirements.
 2. Prior to application, verify concrete floor surfaces are free of laitance and construction materials.
 3. Verify concrete has been in place a minimum of 28 days prior to the commencement of application.
 4. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Deliver materials to site in original, factory sealed, unopened, new containers bearing manufacturer's name and label intact and legible, with the following information:

1. Name or title of material.
 2. Manufacturer's standard container drum numbers.
 3. Thinning instructions.
 4. Application instructions.
- B. Storage:
1. Store materials in protected and well-ventilated area at temperatures between 40 degrees F and 90 degrees F unless otherwise required by manufacturer:
 - a. Keep containers sealed until ready for use.
 - b. Do not use materials beyond manufacturer's shelf life limits.
- C. Existing Concrete:
1. On existing concrete substrates, remove mastics, adhesives, paint, and foreign matter:
 - a. Clean concrete surfaces free of dirt, debris, paint/oil splatters and other residue.
 - b. Remove curing compounds and sealers from concrete surfaces.
 - c. Leave concrete surfaces clean and dry, ready for polishing process.
 - d. Protect adjacent surfaces and finishes from damage by concrete polishing procedures.
 - e. Fill control joints and shave prior to grinding and polishing.
- D. New Concrete:
1. Verify new concrete has been in place for a minimum of 30 days.
- E. Cleaning Substrate:
1. Remove curing, sealing and coating agents, oil, breaking compound residue, wax, and grease by scraping off heavy deposits mechanically or chemically to assure penetration of product into surface:
 - a. Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water.
 - b. Remove dust and loose material by brushing, sweeping, vacuuming, and blowing with high pressure air.
 - c. Remove paint residue with solvent/stripper, provided the stripper does not have an acidic pH.
 - d. Remove tire marks and residue with recommended non-acidic cleaning agents:
 - e. Comply with manufacturer's detailed instructions prior to mixing and removal.
 - f. Dilute cleaning agent in recommended proportions to avoid etching concrete and opening of concrete pores.
 - g. Power scrub and rinse floor surface to remove soap residue and contaminants.
 - h. Squeegee dry.
 - i. No hazardous, flammable, toxic, or solvent based cleaning materials are permitted.
 2. Grind protrusions flush with surface. Patch voids, holes, and cracks with recommended cementitious patching compound compatible with floor finish.
 3. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and contaminants.
 4. Protect surrounding and adjacent surfaces in accordance with floor finish manufacturer's written recommendations. Do not apply tape to the floor.
- F. Formwork:
1. Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.

3.3 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. On Project Site: Mix in drum-type batch mixer, complying with ASTM C685/C685M.
1. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

3.4 INSTALLING REINFORCEMENT FOR NEW CONCRETE SLABS

- A. Comply with requirements of CRSI (DA4) and ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

3.5 PLACING SEPARATE FLOOR TOPPINGS

- A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
- B. Apply bonding agent to substrate minimum of 24 hours in advance in accordance with manufacturer's instructions.
- C. Place concrete floor toppings to required lines and levels to match approved mock-ups.

3.6 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Measure FF Floor Flatness and FL Floor Levelness in accordance with ASTM E1155 (ASTM E1155M) and following ACI 117 using 3D laser imaging within 72 hours after slab installation; report both composite overall values and local values for each measured section.

3.7 CONCRETE FINISHING

- A. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include surfaces to be polished, pigmented concrete, surfaces to receive liquid hardeners, and surfaces to receive dry-shake hardeners.
- B. Curing:
 - 1. Water retention 0.0006 psi (0.40 kg/sq m) in accordance with ASTM C156.
- C. Staining:
 - 1. Prepare surfaces according to manufacturer's written instructions and as follows:
 - a. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
 - b. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by grinding, sanding, or abrasive blasting. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
 - c. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid resistant nylon bristle brushes until bubbling stops and concrete surface has texture of 120 grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
 - 2. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F710 to ensure pH is between 7 and 8.
 - 3. Scoring: Score decorative jointing in concrete surfaces 1/16 inch (1.6 mm) deep with diamond blades to match pattern indicated. Rinse until water is clear. Score after staining.
 - 4. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain according to ASTM D4263 by tightly taping 18 by 18 inches (450 by 450 mm) 18 inch by 18 inch (450 mm by 450 mm), 4 mil (0.1 mm) thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
 - 5. Reactive Stain:
 - a. Apply reactive stain to concrete surfaces according to manufacturer's written instructions and as follows:

- b. Apply stain by uncolored bristle brush, roller, or high volume, low pressure sprayer and immediately scrub into concrete surface with uncolored, acid resistant nylon bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 - c. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.
- 6. Penetrating Stain:
 - a. Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:
 - b. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
 - c. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 - d. Rinse until water is clear. Control, collect, and legally dispose of runoff.

3.8 CONCRETE POLISHING

- A. Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer-approved installer.
- B. Apply one coat of undiluted densifier solution to point of rejection, remove excess liquid, and cure in accordance with manufacturer's instructions. Repeat with second coat.
- C. Fill surface imperfections utilizing manufacturer-recommended materials, and apply grout to continuous monolithic surface.
- D. Final Polished Concrete Aggregate Exposure: CPC Class A - Cement Fines; cement fines, 85 to 95 percent; fine aggregates, 5 to 15 percent based on visual observation of overall area of polished floor versus Polished Concrete Aggregate Exposure Chart.
- E. Final Polished Concrete Appearance: CPC Level 3 - Polished, image clarity value 40 to 69 percent with haze index less than 10.
- F. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup:
 - 1. Grind concrete floor to within five inches (5") of walls and partitions using SF-40 grit, removing construction debris and floor slab imperfections and imparting a uniform scratch pattern in concrete surfaces. Thoroughly vacuum floor using a squeegee vacuum attachment to completely remove dust and debris.
 - 2. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
 - 3. Apply liquid densifier and/or reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
 - 4. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time, approximately two (2) hours, between successive coats. Remove excess material from surfaces.
 - 5. Grind concrete floor to within five inches (5") of walls and partitions using metal bonded diamond grits in a finer grit for each polishing, grinding 90 degrees from each previous grind and removing scratches from each previous grind. After each grind, thoroughly vacuum floor using a squeegee vacuum attachment to completely remove dust and debris.
 - 6. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
 - 7. Continue polishing with progressively finer grit diamond polishing pads to gloss level, to match approved mockup.

8. Control and dispose of waste products produced by grinding and polishing operations.
 9. Neutralize and clean polished floor surfaces.
- G. Sealing: Apply two coats of manufacturer-recommended sealer, and burnish to uniform sheen.

3.9 FIELD QUALITY CONTROL

- A. Defective Concrete: Repair or replace concrete not complying with required lines, details, dimensions, tolerances, or specified requirements at no additional cost to Owner.
- B. Slip Resistance: Minimum 0.43 in accordance with ANSI A326.3 after polishing.
- C. Final Polished Concrete Appearance: Test image clarity value and haze index prior to application of sealer at a rate of three tests per 1000 square feet of polished concrete.
 1. Image clarity: Test with Image Clarity Meter in accordance with ASTM D5767.
 2. Haze index: Test with Glossmeter in accordance with ASTM D4039.
 3. Match approved mock-ups.

3.10 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.
- B. Protect finished surface as required and as recommended by manufacturer of polishing system until project is turned over to Owner.

END OF SECTION 03 35 43

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SECTION 03 36 00 – POLISHED CONCRETE FLOOR

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The provisions of the General Conditions, Supplementary Conditions, Drawings, Specifications, and the Sections included under Division 1, General Requirements and References are included as a part of this Section as though bound herein.

1.2 SUMMARY

- A. Section Includes
 - 1. Provide labor, materials, services, and equipment necessary to furnish and install work as indicated and as specified herein, which includes, but is not limited to:
 - a. Stain and seal concrete floor.
 - b. Polish concrete floor.

1.3 REFERENCES

- A. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- B. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
- C. ASTM C779 – Standard Test Method for Abrasion of Horizontal Concrete Surfaces.
- D. ASTM C805 – Impact Strength.
- E. ASTM G23-81 – Ultraviolet Light and Water Spray.
- F. ASTM 1028 – Co-efficient of Friction.

1.4 ACTION SUBMITTALS

- A. Product Data: Provide data on products specified.
- B. Environmental Data: Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under the work of this section.
- C. Submit Applicators qualifications data.
- D. Samples: Three samples 12" x 12" for each type of polished concrete finish required.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Provide products from a firm that makes the indicated products as a regular production item and with not less than ten (10) years experience.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation of specified materials and assemblies with not less than five (5) years experience. Work shall be installed by a Certified Applicator; and Contractor shall provide adequate number of skilled workers thoroughly trained and experienced in the

necessary craft.

- C. Manufacturers Certification: Provide certification letter from and chemical manufacturer stating the installer is a certified applicator and is familiar with proper procedures and installation requirements required by the manufacturer.

1.6 MOCK-UPS

- A. Reserve 100 SF for the mock-up location should be where floor coverings will be installed at a later date. Place mock-up slab on the same day and same pour as the floors to receive polish.
- B. Install mock-ups to verify selections made under the sample submitted and to demonstrate methods, appearance, and workmanship proposed for the project.
- C. Test aggregate to ensure it will accept polish.
- D. Include control joints in the mock-up, contractor may saw as soon as the surface is firm enough not to displace any aggregate.
- E. Also, include edge conditions in the mock-up.
- F. Approved mock-ups may become part of the completed work if accepted by the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products per manufacturer's recommendations.
- B. Deliver materials in manufacturer's packaging including application instructions.

1.8 FIELD CONDITIONS

- A. Temporary Lighting: Provide minimum 200 W light source, 8' above the floor surface, for each 425 sq. ft. of floor being finished.
- B. Environmental Conditions: Maintain an ambient temperature of between 50° and 80° F during application and at least 48 hours after application.
- C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.
- D. Comply with the manufactures written instructions for substrate temperature, moisture content, ambient temperature and humidity, ventilation, and other conditions affecting chemical performance.

1.9 WARRANTY

- A. Provide ten (10) year manufacturer's warranty on Floor Stain and twenty (20) year manufacturer's warranty on Floor Sealer.

1.10 PERFORMANCE

- A. Completed installation shall provide an entire floor surface with a slip coefficient of friction of 0.6 or greater.
- B. Follow manufacturer's Technical Bulletins for all products and installation.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer shall be the following however products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product and acceptance is provided by the Architect in writing prior to bidding.
 - 1. Scofield, A Sika Brand.

2.2 SYSTEM

- A. Basis of Design: "Formula One System"

2.3 MATERIALS

- A. Stain: Solvent based color liquid dye concentrate.
- B. Sealer: Water based high solids urethane fortified acrylic sealer "Selectseal Plus."

2.4 SLIP RESISTANT TREATMENT

- A. Slip Resistant Finish: Aluminum oxide type, color as selected from manufacturer's standard range.

2.5 POLISHING EQUIPMENT

- A. 3-head or 4-head counter rotating variable speed grinder.
- B. Use a dust extraction system, pre-separator, and squeegee attachments.
- C. Grinding Head
 - 1. Metal bonded 16, 25, 40, 80, 150, and/or 300 grits.
 - 2. Bonded resin diamonds 100, 200, and 400 grits.
- D. Grinding Pads for Edges
 - 1. 40, 60, and 120 metal grits
 - 2. 100, 200, and 400 resin grits
- E. Hand grinder with dust extraction attachment and pads.

- F. Finish: Grade1– Light Sand Finish
- G. Finish: Grade 2 – Salt and Pepper Finish
- H. Finish: Grade 3 – Aggregate Finish
- I. Class 1 – Low Reflectivity Sheen, to provide acceptable slip resistant/coefficient of friction.
- J. Class 2 – Medium Reflectivity Sheen, to provide acceptable slip resistant/coefficient of friction.
- K. Class 3 – High Reflectivity Sheen, to provide acceptable slip resistant/coefficient of friction.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Installer shall examine and approve concrete substrate for conditions affecting performance of the finished polished concrete slab. Specifically, flatness and finish troweling.
- C. General Contractor shall correct any conditions found not in compliance with this section.
- D. Architect shall approve the repairs based on the requirements of this section.
- E. Provide floor clean of materials and debris prior to polishing subcontractor start.
- F. Protect adjacent surfaces as necessary to prevent damage by concrete polishing procedure.

3.2 PREPARATION

- A. In areas with floor drains, maintain design floor elevation at walls, slope surfaces uniformly to drains as indicated on plans.
- B. Grind concrete floor per manufacturer's instructions with progressive pad grits and finishing with 400 grit pads to open pores in concrete floor.
- C. See plans for locations and type of specialized floor finish, color, and treatment in accordance with the design intent; contractor shall coordinate with architect all field samples and installations. All grinding shall be in a cross-hatch pattern and as recommended by the manufacturer.
- D. Clean concrete surfaces thoroughly with an autoscrubber so that surfaces are completely penetrable before receiving the initial application of chemical stain. Test surfaces to receive stain by spotting with water. Water should immediately darken the substrate and be readily absorbed. If water beads and does not penetrate or only penetrates in some areas, additional surface preparation and testing shall be performed. On denser floors, acid wash with a solution of one-part muriatic acid (20o Baume or 31.4 percent pool acid) to 20 parts water, or sand lightly to open up surfaces. Retest and continue surface preparation until water spots immediately darken and uniformly penetrate concrete surfaces.
- E. Cleaning methods used depends on the condition of the concrete surface. To remove dirt and other contaminants, detergents and other commercial grade cleaners should be considered and tested.

- F. Rinse concrete substrates until rinse water is completely clean.
- G. Fill construction joints and cracks with filler products as specified in the manufacturer's instructions colored to match (or contrast) with the concrete color specified by the Architect.
- H. Apply preparation material, stain, and sealer per manufacturer's recommendations.

3.3 APPLICATION OF CHEMICAL STAIN

- A. Concrete surfaces shall be dry and properly prepared as described above. Protect surrounding areas from over-spray, run-off, and tracking. Divide surfaces into small work sections using wall, joint lines, or other stationary breaks as natural stopping points.
- B. Apply chemical stains full strength (undiluted) at the coverage rate recommended by the manufacturer and use application equipment described in the manufacturer's printed technical literature. The color of the liquid chemical stain has no resemblance to the final color produced on the concrete substrate.
- C. Chemical stains normally fizz when reacting with the concrete. If fizzing does not occur, the substrate has not been adequately prepared or the concrete pH level is too low. If this should happen, contact the local representative for further recommendations.
- D. Transfer chemical stain to the substrate by brush or spray and immediate scrub into surface.
- E. Reaction time depends on wind conditions, temperatures, and humidity levels.
- F. When multiple coats of one or more colors are required, washing, and drying between colors is desirable to evaluate the color prior to the next coat.
- G. After the final coat of chemical stain has remained on the surface for a minimum of four hours, remove all residue by wet scrubbing with commercial grade detergent. Rinse surfaces after scrubbing until rinse water is completely clean. Run off may stain the adjacent areas or harm plants. Collect rinse water by wet vacuuming or absorbing with an inert material.

3.4 APPLICATION OF SEALER

- A. Concrete substrate shall be completely dry.
- B. Test surface for proper pH level prior to applying sealer.
- C. Apply sealer according to manufacturer's written instructions at a rate of 300 to 500 square feet per gallon per coat and maintain a wet edge at all times.
- D. Allow sealer to completely dry before applying additional coats. Apply second coat of sealer at 90° the direction of the first coat using the same application method and rates.
- E. Seal horizontal joints in areas subject to pedestrian or vehicular traffic.

3.5 PROTECTION

- A. Protect the floors from damage as required.

END OF SECTION 03 36 00

SECTION 04 01 20 - MAINTENANCE OF UNIT MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes special requirements for maintenance of existing unit masonry, including:
 - 1. Repairing unit masonry, including replacing units.
 - 2. Re-anchoring veneers.
 - 3. Repointing joints.
- B. Related Sections:
 - 1. Section 04 05 00 - Common Work Results for Masonry: Quality assurance requirements, mortar, grout, ties and anchors, reinforcement, embedded flashing, masonry water repellent, masonry accessories, and masonry cleaning.
 - 2. Section 04 20 00 - Unit Masonry: Brick veneer unit masonry, Single-Wythe CMU walls and CMU backup walls, and Concrete masonry units (CMU) for veneer.
 - 3. Section 04 43 00 - Stone Masonry.
 - 4. Section 04 72 00 - Cast Stone Masonry
 - 5. Section 04 73 23 - Lightweight Synthetic Stone: Manufactured stone veneer, thin brick, and trim.

1.3 REFERENCE STANDARDS

- A. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Technical data for each type of product, including material descriptions and application instructions and test data substantiating that products comply with requirements.
- B. Shop Drawings for the Following:
 - 1. Provisions for expansion joints or other sealant joints.
 - 2. Replacement and repair of anchors. Include details of anchors within individual masonry units, with locations of anchors and dimensions of holes and recesses in units required for anchors.
 - 3. Field investigation report outlining work required after existing construction is removed from masonry surface.

1.5 QUALITY ASSURANCE

- A. Paint Remover Manufacturer Qualifications:
 - 1. Firm having minimum 5 years' documented experience who regularly engages in producing masonry cleaners, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
- B. Chemical Cleaner Manufacturer Qualifications: Firm having minimum 5 years' documented experience who is regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
 - 1. Firm having minimum 5 years' documented experience who is regularly engaged in producing masonry cleaners that have been used for similar applications with successful

results, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.

C. Cleaning Program:

1. Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage:
 - a. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.

D. Mockups:

1. Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution:
 - a. Clean an area approximately 25 sq. ft (2.3 sq. m) for each type of masonry and surface condition:
 - 1) Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
 - 2) Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless the Architect specifically approves such deviations in writing.

E. Preconstruction Testing Service:

1. Engage one or more chemical cleaner and paint remover manufacturer(s) to perform preconstruction testing on masonry surfaces:
 - a. Use test areas as indicated and representative of proposed materials and existing construction.
 - b. Propose changes to materials and methods to suit.

F. Pre-Installation Conference:

1. Conduct conference at Project site:
 - a. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
 - 1) Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
 - 2) Materials, material application, and sequencing.
 - 3) Cleaning program.
 - 4) Coordination with building occupants.

1.6 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform masonry cleaning Work in the following sequence:

1. Remove plant growth.
2. Inspect for open mortar joints. Where repairs are required, delay further cleaning Work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry surfaces.
5. Where water repellents are to be used on or near masonry, delay application of chemicals until after cleaning.

1.7 FIELD CONDITIONS

- A. Weather Limitations:
 - 1. Proceed with installation when existing and forecasted weather conditions permit masonry cleaning Work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 degrees F (4 degrees C) and above and is predicted to remain so for at least seven days after completion of cleaning.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).

2.2 CLEANING MATERIALS

- A. Refer to Section 04 05 00 - Common Work Results for Masonry.

2.3 ACCESSORY MATERIALS

- A. Refer to Section 04 05 00 - Common Work Results for Masonry.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation when existing and forecasted weather conditions permit masonry cleaning work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 degrees F (4 degrees C) and above and is predicted to remain so for at least seven days after completion of cleaning.

3.2 SEQUENCING AND SCHEDULING

- A. Perform masonry cleaning work in the following sequence:
 - 1. Remove plant growth.
 - 2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
 - 3. Remove paint.
 - 4. Clean masonry surfaces.
 - 5. Where water repellents are to be used on or near masonry, delay application of chemicals until after cleaning.

3.3 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by contact:
 - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
 - 3. Neutralize alkaline and acid wastes before disposal.

4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove gutters and/or downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete:
 1. Provide temporary rain drainage during work to direct water away from building.

3.4 CLEANING MASONRY

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by the Architect.
- B. Proceed with cleaning working from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use cleaning methods indicated for each masonry material and location:
 1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
 2. Spray equipment:
 - a. Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints:
 - 1) Equip units with pressure gages.
 - 2) For chemical cleaner spray application, use low pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone shaped spray.
 - 3) For water spray application, use fan shaped spray that disperses water at an angle of 25 to 50 degrees.
 - 4) For high pressure water spray application, use fan shaped spray that disperses water at an angle of at least 40 degrees.
 - 5) For heated water spray application, use equipment capable of maintaining temperature between 140 and 160 degrees F (60 and 71 degrees C) at flow rates indicated.
 - 6) For steam application, use steam generator capable of delivering live steam at nozzle.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed, so cleaned surfaces blend smoothly into surrounding areas.
- F. Water Application Methods:
 1. Water soak application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
 2. Water spray applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches (150 mm) from masonry surface and apply

steam in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.

- H. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed:
 - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
- J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.5 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning:
 - 1. Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar:
 - a. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
 - b. Remove paint and sealant with alkaline paint remover:
 - 1) Comply with requirements.
 - 2) Repeat application up to two times if needed.
 - c. Remove asphalt and tar with solvent type paste paint remover:
 - 1) Comply with requirements.
 - 2) Apply paint remover only to asphalt and tar by brush without prewetting.
 - 3) Allow paint remover to remain on surface for 10 to 30 minutes.
 - 4) Repeat application if needed.

3.6 CLEANING MASONRY

- A. Cold Water Soak:
 - 1. Apply cold water by intermittent spraying to keep surface moist.
 - 2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
 - 3. Apply water in cycles of 5 minutes on and 20 minutes off.
 - 4. Continue spraying until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests.
- B. Cold Water Wash: Use cold water applied by low, medium, or high pressure spray.
- C. Hot Water Wash: Use hot water applied by low, medium, or high pressure spray.
- D. Steam Cleaning: Apply steam at very low pressures not exceeding 80 psi (550 kPa). Remove dirt softened by steam with wood scrapers, stiff nylon or fiber brushes, or cold-water wash, as indicated by cleaning tests.
- E. Detergent Cleaning:
 - 1. Wet surface with water applied by low pressure spray.

2. Scrub surface with detergent solution using medium soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used, and that surface remains wet.
 3. Rinse with water applied by high pressure spray to remove detergent solution and soil.
 4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- F. Mold, Mildew, and Algae Removal:
1. Wet surface with water applied by low pressure spray.
 2. Apply mold, mildew, and algae remover by brush.
 3. Scrub surface with medium soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used, and that surface remains wet.
 4. Rinse with cold water applied by medium pressure spray to remove mold, mildew, and algae remover and soil.
 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- G. Non-Acidic Gel Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
 2. Apply gel cleaner in 1/8 inch (3 mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Remove bulk of gel cleaner.
 5. Rinse with water applied by low pressure spray to remove chemicals and soil.
 6. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- H. Nonacidic Liquid Chemical Cleaning:
1. Wet surface with water applied by low pressure spray.
 2. Apply cleaner to surface in two applications by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- I. Mild Acid Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
 2. Apply cleaner to surface in two applications by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- J. Acidic Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.

2. Apply cleaner to surface in two applications by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
- K. One-Part Limestone Chemical Cleaning:
1. Wet surface with water applied by low pressure spray.
 2. Apply cleaner to surface by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
 5. Rinse with water applied by medium pressure spray to remove chemicals and soil.
- L. Two-Part Chemical Cleaning:
1. Wet surface with hot water applied by low pressure spray.
 2. Apply alkaline prewash cleaner to surface by brush or roller.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer unless otherwise indicated.
 4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 5. Apply acidic afterwash cleaner to surface in two applications, while surface is still wet, using low pressure spray equipment, deep nap roller or soft fiber brush. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
 6. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 7. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer Field Service: Engage paint remover manufacturer's and chemical cleaner manufacturer factory authorized service representatives for consultation and Project site inspection, to perform preconstruction product testing, and provide onsite assistance when requested by the Architect. Have paint remover manufacturer and chemical cleaner manufacturer factory authorized service representatives visit site not less than once to observing progress and quality of the work.

3.8 FINAL CLEANING

- A. Clean adjacent non-masonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

END OF SECTION 04 01 20

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SECTION 04 05 00 - COMMON WORK RESULTS FOR MASONRY

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Mortar and grout for masonry assemblies.
 - 2. Ties and anchors.
 - 3. Embedded flashing.
 - 4. Penetrating water repellents.
 - 5. Miscellaneous masonry accessories.
 - 6. Cleaning exposed unit masonry surfaces.
- B. Related Sections:
 - 1. Section 04 01 20 - Maintenance of Unit Masonry: Cleaning of Masonry.
 - 2. Section 05 50 00 - Metal Fabrications: Steel embeds and lintels.
 - 3. Section 07 92 00 - Joint Sealants: Sealants for control and expansion joints.

1.3 REFERENCE STANDARDS:

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- E. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- G. ASTM B32 - Standard Specification for Solder Metal; 2020.
- H. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- I. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.
- J. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
- K. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- L. ASTM C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement; Current Edition.
- M. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- N. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- O. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- P. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

- Q. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.
- R. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- S. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- T. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.
- U. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- V. ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- W. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
- X. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber; 2020.
- Y. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
- Z. ASTM D2287 - Standard Classification System and Basis for Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; Current Edition.
- AA. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- BB. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- CC. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.4 DEFINITIONS

- A. Very Low Pressure Spray: Under 100 psi (690 kPa).
- B. Low Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Mix design for mortar and grout shall be submitted for review.
- C. Supplier's certificates indicating materials comply with the specifications below. They shall include, but are not necessarily limited to:
 - 1. Aggregates.
 - 2. Cement.
 - 3. Admixtures.
- D. Shop Drawings:
 - 1. For the following:
 - a. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- E. Samples for Initial Selection:
 - 1. Colored mortar.
 - 2. Weep holes/vents.
- F. Samples for Verifications:
 - 1. For each type and color of the following:

- a. Pigmented and colored-aggregate mortar. Make samples using same sand and mortar ingredients to be used on Project.
 - b. Weep holes and vents.
 - c. Accessories embedded in masonry.
- G. Material Certificates:
 - 1. For each type and size of the following:
 - a. Cementitious materials. Include brand, type, and name of manufacturer.
 - b. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - c. Grout mixes. Include description of type and proportions of ingredients.
 - d. Anchors, ties, and metal accessories.
- H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- B. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 - Project Management and Coordination.
- C. Tests and Inspections:
 - 1. All tests and inspections herein are to be performed by an independent testing laboratory approved by the building official.
 - 2. Mortar and Grout Tests:
 - a. At the beginning of masonry work, at least one test sample each of mortar and grout shall be taken on three successive working days, then once per week with at least one sample taken for each 5,000 sq. ft. (465 sq. m) of wall area, or fraction thereof:
 - 1) Test specimens shall be made in accordance with ASTM C1019 for grout and ASTM C780 for mortar.
 - 2) Test specimens shall be continuously stored in moist air until tested.
 - 3) Mortar shall show a compressive strength of not less than 1,800 psi at 28 days. Grout shall show a compressive strength of not less than 2,000 psi at 28 days.
- D. Paint Remover Manufacturer Qualifications: Firm having minimum five years' documented experience who regularly engages in producing masonry cleaners, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
- E. Chemical Cleaner Manufacturer Qualifications: Firm having minimum five years' documented experience who is regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory authorized service representatives who are available for consultation and site inspection, preconstruction product testing, and onsite assistance.
- F. Cleaning Program:
 - 1. Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage:
 - a. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.

- G. Pre-Installation Conference:
 - 1. Conduct conference at Project site:
 - a. Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
 - b. Materials, material application, and sequencing.
 - c. Cleaning program.
 - d. Coordination with building occupants.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 2. Fire Code:
 - a. Comply with applicable requirements of International Fire Code ICC (IFC).

2.2 MORTAR AND GROUT MATERIALS

- A. Portland Cement
 - 1. ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - a. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime:
 - 1. ASTM C207, Type N or S as indicated in masonry section.
- C. Portland Cement-Lime Mix:
 - 1. Packaged blend of Portland cement and hydrated lime, complying with specified requirements and containing no other ingredients.
- D. Masonry Cement: ASTM C91/C91M.
- E. Quicklime: ASTM C5.
- F. Lime Putty:
 - 1. Made from hydrated lime or quicklime:
 - a. If made from quicklime, other than processed pulverized quicklime, slake lime and then screen through a No. 16 mesh sieve. Before using, store and protect slaked and screened lime putty for not less than 10 days.
 - b. Processed pulverized quicklime shall be slaked for not less than 48 hours, and shall be cool when used.
 - c. Lime putty prepared from hydrated lime may be used immediately after mixing.

- d. Lime putty prepared from quicklime or pulverized quicklime shall have a plasticity figure, after slaking and screening, of not less than 200, and shall weigh not less than 83 pounds per cubic foot. Lime putty prepared from hydrated lime shall conform to ASTM C207, Type S.
- G. Aggregate:
 - 1. For mortar: ASTM C144.
 - 2. For grout: ASTM C404.
- H. Admixtures:
 - 1. Water Repellent Admixture:
 - a. Liquid water repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer:
 - 1) Manufacturers:
 - (a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (1) BASF Corporation; Construction Systems: www.basf.com.
 - (2) Euclid Chemical Company (The); an RPM company: www.euclidchemical.com.
 - (3) GCP Applied Technologies: www.gcpat.com.
 - (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- I. Mortar Pigments:
 - 1. Natural and synthetic iron oxides and chromium oxides compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar:
 - a. Manufacturers:
 - 1) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (a) Davis Colors: www.davoscolors.com.
 - (b) Lanxess Corporation: www.lanxess.com/en..
 - (c) Solomon Colors, Inc.: www.solomoncolors.com.
 - 2) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (a) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- J. Water: Potable.

2.3 MORTAR MIXES

- A. General:
 - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated:
 - a. Do not use calcium chloride in mortar.
 - b. Use masonry cement or mortar cement mortar unless otherwise indicated.
 - c. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Pre-Blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 - 1. Manufacturers
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - 2. Basis of Design :
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide Type S or Type N as indicated in related Section.
 - 1. Type S mortar shall have a 28 day compressive strength of not less than 1,800 psi (12.4 MPa).
- D. Mortar shall be made with admixtures that are proportioned, added and mixed in strict accordance with manufacturer's directions.
- E. Mortar mix shall be proportioned by volume; one-part portland cement, not less than 1/4 part nor more than 1/2 part lime putty, and sand totaling not less than 2-1/4 nor more than 3 times sum of volumes of cement and lime used:
 - 1. Total clay content shall not exceed 2 percent of sand content or six percent 6 percent of cement content.

2.4 GROUT MIXES

- A. Grout for Unit Masonry: Comply with ASTM C476.
 - 1. Grout shall have a 28-day compressive strength of not less than 2,000 psi (13.7 MPa). Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.
 - 2. Proportion by volume and with sufficient water to produce consistency for pouring without segregation so that grout will flow into masonry joints.
- B. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that complies with TMS 402/602 for dimensions of grout spaces and pour height.
 - 1. Fine Grout:
 - a. One-part portland cement, to which may be added not more than 1/10 part lime putty, and 3 parts sand.
 - b. Fine grout shall be used for all grout spaces less than 3 inches (76 mm) wide.
 - 2. Coarse Grout:
 - a. One-part portland cement, to which may be added not more than 1/10 part lime putty, 3 parts sand, and not less than one-part nor more than two-parts pea gravel (3/8 inch (10 mm) maximum aggregate size).
 - b. Coarse grout shall be used in grout spaces 3 inches (76 mm) wide or more.
- C. Grout Additive:
 - 1. Sika Grout Aid admixture to grout at the rate of 1 pound per 100 pounds cementitious material.

2.5 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A951/A951M.
 - 1. Masonry joint reinforcement used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B, minimum coating of 1.5 ounce for square foot.

- B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187 inch (4.7 mm) diameter, hot-dip galvanized, carbon-steel continuous wire.
- C. Reinforcing Bars:
 - 1. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
- D. Reinforcing Bar Positioners:
 - 1. Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Form units from 0.148 inch (3.77 mm) steel wire, hot dip galvanized after fabrication. Provide units designed for number of bars indicated:
 - 2. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Heckmann Building Products, Inc.: www.heckmanbuildingproducts.com.
 - 2) Hohmann & Barnard, Inc.: www.h-b.com.
 - 3) Wire-Bond: www.wirebond.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.6 TIES AND ANCHORS

- A. General:
 - 1. Sheet Metal Anchors and Ties - ASTM A1008/A1008M:
 - a. Sheet metal anchors and ties used in exterior walls shall be hot-dipped galvanized, conforming to ASTM A153/A153M, Class B.
- B. Wire Ties and Anchors:
 - 1. General:
 - a. Provide ties and anchors made from materials complying with the following unless otherwise indicated:
 - 2. Individual Wire Ties:
 - a. W-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inch (50 mm) long.
 - b. Wire: Fabricate from #9 AWG corrosion resistant wire.
- C. Adjustable Masonry-Veneer Anchors:
 - 1. General:
 - a. Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
 - 1) Structural Performance Characteristics: Capable of withstanding a 100 lbf (445 N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.27 mm).
 - 2. Contractor's Option:
 - a. Unless otherwise indicated, provide any of the following types of anchors:
 - 1) Screw-attached, masonry-veneer anchors: Units consisting of a wire tie and a metal anchor section.
 - 2) Manufacturers:
 - (a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (1) Heckmann Building Products, Inc.: www.heckmanbuildingproducts.com.

- (2) Hohman & Barnard: www.h-b.com.
- (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- 3) Anchor Section:
 - (a) Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (76 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
 - (b) Sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches (140 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.
 - (c) Gasketed sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
 - (d) Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.
 - (e) Fabricate sheet metal anchor sections and other sheet metal parts from 0.075 inch (2 mm) thick, steel sheet, galvanized after fabrication.
- 4) Wire Ties:
 - (a) Triangular, rectangular, or T-shaped wire ties fabricated from 0.187 inch (5 mm) diameter, hot-dip galvanized steel wire.
- 3. Polymer-Coated, Steel Drill Screws for Steel Studs:
 - a. ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B117:
 - 1) Manufacturers:
 - (a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (1) Elco, a DeWalt brand: www.dewalt.com.
 - (2) ITW Buildex: www.ITW_Buildex.com.
 - (3) Leland Industries Inc.: www.lelandindustries.com.
 - (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - 2) Basis of Design Products :
 - (a) Dril-Flex with Stalgard finish manufactured by Elco.
 - (b) Teks Maxiseal with Climaseal finish manufactured by ITW Buildex.

- (c) Master Drillers with DT2000 Longlife Coating and Master Seal Bonded Washer manufactured by Leland Industries Inc.: .
- 4. Stainless-Steel Drill Screws for Steel Studs:
 - a. Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads:
 - 1) Manufacturers:
 - (a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (1) ITW Buildex: Teks Scots.
 - (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - 2) Basis of Design Product:
 - (a) Teks Scots manufactured by ITW Buildex.

2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034 inch (0.9 mm) galvanized steel sheet.

2.8 EMBEDDED FLASHING MATERIALS

- A. Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and/or Section 07 62 00 - Roof Related Sheet Metal and as follows:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch (0.4 mm) thick.
 - 2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16 oz. / sq. ft. (4.9 kg / sq. m) weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12 oz. / sq. ft. (3.7 kg / sq. m) weight or 0.0162 inch (0.41 mm) thick.
 - 3. Fabricate continuous flashings in sections 96 inches (2,438 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
 - 4. Fabricate through-wall metal flashing embedded in masonry from copper, with ribs at 3 inch (76 mm) intervals along length of flashing to provide an integral mortar bond:
 - a. Manufacturers:
 - 1) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (a) Cheney Flashing Company: www.cheneyflashing.com.
 - (b) Keystone Flashing Company, Inc: www.keystoneflashing.com.
 - 2) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (a) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - b. Basis of Design Product:
 - 1) Cheney Flashing (Dovetail) manufactured by Cheney Flashing Company.
 - 2) Keystone 3-Way Thruwall Flashing manufactured by Keystone Flashing Company, Inc: .
 - 5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
 7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
 8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inch (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
 9. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inch (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
 10. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inch (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
 11. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing:
1. Use one of the following unless otherwise indicated:
 - a. Copper-Laminated Flashing: 5 oz. / sq. ft. (1.5 kg / sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry:
 - 1) Manufacturers:
 - (a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - 2) Basis of Design Products:
 - b. Asphalt-Coated Copper Flashing: 7 oz. per sq. ft. (2.1 kg per sq. m) copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry:
 - 1) Manufacturers:
 - (a) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (1) Advanced Building Products Inc.: www.advancedbuildingproducts.com.
 - (2) Hohmann & Barnard, Inc.: www.h-b.com.
 - (b) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - 2) Basis of Design Products :
 - 3) Accessories:
 - (a) Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application:
1. Unless otherwise indicated, use the following:
 - a. Where flashing is indicated to receive counterflashing, use metal flashing.

- b. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 - c. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge with a sealant stop or flexible flashing with a metal sealant stop.
 - d. Where flashing is fully concealed, use flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings:
 - 1. Solder for stainless steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 - 2. Solder for copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.9 LIQUID SURFACE TREATMENTS

- A. Penetrating Water Repellent:
 - 1. Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components, odorless, that penetrates, hardens, and densifies concrete surfaces:
 - 2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 3. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Moxie International Inc.: www.moxieshield.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - 4. Basis of Design Product:
 - a. Moxie Shield 1400 Surface Sealer.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane.
- B. Preformed Control Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products - Use one of the following unless otherwise indicated:
 - 1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, 1/4 inch (6 mm) to 3/8 inch (10 mm) in diameter, in length required to produce 2 inches (51 mm) exposure on exterior and 18 inches (457 mm) in cavity. Use only for weeps.
 - 2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8 inch (10 mm) OD by 4 inches long.

3. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 inch (10 mm) by 1-1/2 inches (38 mm) by 3-1/2 inches (89 mm).
4. Mesh Weep/Vent:
 - a. Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard:
 - b. Manufacturers:
 - 1) Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - (a) Mortar Net Solutions: www.mortarnet.com.
 - 2) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (a) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- E. Cavity Drainage Material:
 1. Free draining mesh, made from polymer strands that will not degrade within the wall cavity.
 2. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Advanced Building Products Inc.: www.advancedbuildingproducts.com.
 - 2) Heckmann Building Products, Inc.: www.heckmannbuildingprods.com.
 - 3) Hohmann & Barnard, Inc.: www.h-b.com.
 - 4) Mortar Net Solutions: www.mortarnet.com.
 - 5) Wire-Bond: www.wirebond.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 3. Configuration:
 - a. Strips, full depth of cavity and 10 inches (254 mm) high, with dovetail shaped notches 7 inches (178 mm) deep that prevent clogging with mortar droppings.

2.11 CLEANING MATERIALS

- A. Water:
 1. Potable.
- B. Hot Water:
 1. Water heated to a temperature of 140 to 160 degrees F (60 to 71 degrees C).
- C. Detergent Solution, Job Mixed:
- D. Mold, Mildew, and Algae Remover, Job Mixed:
 1. Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 qt (5 L) of five percent sodium hypochlorite (bleach), and 15 qt (15 L) of hot water for every 20 quarts (19 L) of solution required.
- E. Non-Acidic Gel Cleaner:
 1. Gel formulation, with pH between 6 and 9 that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces:
 2. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

- 1) AHI Supply Co.: www.ahi-supply.com.
 - 2) PROSOCO, Inc.: www.prosoco.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- F. Non-Acidic Liquid Cleaner:
 1. Mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood:
 2. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) AHI Supply Co.: www.ahi-supply.com.
 - 2) Diedrich Technologies, Inc.; a division of Sandell Construction Solutions: www.diedrichtechnologies.com.
 - 3) PROSOCO, Inc.: www.prosoco.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- G. Mild acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches:
 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) AHI Supply Co.: www.ahi-supply.com.
 - 2) Diedrich Technologies, Inc.; a division of Sandell Construction Solutions: www.diedrichtechnologies.com.
 - 3) PROSOCO, Inc.: www.prosoco.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- H. Acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors:
 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) AHI Supply Co.: www.ahi-supply.com.
 - 2) American Building Restoration Products, Inc.
 - 3) PROSOCO, Inc.: www.prosoco.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

- I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.
 - 1. Manufacturers:
 - a. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- J. Two-part chemical cleaner system consisting of potassium - or sodium hydroxide based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid:
 - 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) AHI Supply Co.: www.ahi-supply.com.
 - 2) Diedrich Technologies, Inc.; a division of Sandell Construction Solutions: www.diedrichtechnologies.com.
 - 3) PROSOCO, Inc.: www.prosoco.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.12 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical cleaner manufacturer.
- B. Acidic Cleaner Solution for Non-Glazed Masonry and Unpolished Stone:
 - 1. Dilute acidic cleaner with water to produce hydrofluoric acid content of 3% or less, but not greater than that recommended in writing by chemical-cleaner manufacturer:
 - a. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.
- C. Acidic Cleaner for Galzed Masonry Glazed Masonry and Polished Stone:
 - 1. Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch, or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer:
 - a. Stones: Use only on polished granite and polished dolomite marble.

2.13 MASKING MATERIALS

- A. Liquid Strippable Masking Agent:
 - 1. Liquid, film forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners:
 - 2. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) American Building Restoration Products, Inc.: www.abrp.com.
 - 2) PROSOCO, Inc.: www.prosoco.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

- A. Protection of Masonry:

1. During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress:
 - a. Extend cover a minimum of 24 inches (610 mm) down both sides of walls and hold cover securely in place.
 - b. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (610 mm) down face next to unconstructed wythe and hold cover in place.
- B. Stain Prevention:
 1. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry:
 - a. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - b. Protect sills, ledges, and projections from mortar droppings.
 - c. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - d. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements:
 1. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 402/602:
 - a. Cold-weather cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F (4.4 degrees C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

3.2 COORDINATION

- A. Build openings and chases for heating, plumbing, electrical ducts, pipes, and conduits into masonry walls as necessary. Install bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as necessary:
 1. Coordinate related work incorporating installation of work to prevent subsequent cutting and patching.
 2. Coordinate installation of steel reinforcement for reinforced masonry.
 3. Coordinate dampproofing, waterproofing, and air infiltration membrane activities with masonry construction.
 4. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.

3.3 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work:
 1. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the work.
 2. Verify foundations are within tolerances specified.
 3. Verify reinforcing dowels are properly placed.
 4. Verify substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

- C. Proceed with installation after correcting unsatisfactory conditions.

3.4 MORTAR AND GROUT

- A. Mixing Mortar and Grout
 - 1. Accurately measure materials in suitably calibrated devices; shovel measurements are not acceptable.
 - 2. Place sand, cement, and water in mixer, in that order, and mix for at least 2 minutes. Add lime putty and continue mixing as long as necessary to secure a uniform mass, but in no case less than 10 minutes.
 - 3. Use mixers of at least one sack capacity; batches requiring fractional sacks will not be permitted unless cement is weighed for each batch.
- B. Grouting Procedures
 - 1. As specified in Related Section(s).
- C. Retempering
 - 1. When necessary to retemper mortar, add water and remix; retempering by dashing water over mortar will not be permitted.
 - 2. Any mortar that is unused within 30 minutes after initial mixing and any mortar that has begun to set shall not be used.
- D. Defective Mortar or Grout
 - 1. Should the strength of mortar or grout fall below that specified, remainder of Work shall be adjusted to reach required strength. Work in place representing inferior grout and mortar and indicating a strength less than the minimum specified shall be tested by taking and testing core samples. Number and location of cores shall be determined by Structural Engineer.
 - 2. Should compression tests of cores fail to meet required strength, masonry shall be deemed to be defective and shall be removed and replaced at no cost to the Owner.
 - 3. Costs relative to taking and testing of core samples shall be paid by the Owner and will be deducted from Contract amount. Cost of patching core holes shall be borne by the Contractor.

3.5 INSTALLATION, GENERAL

- A. Construct masonry veneer in compliance with TMS 402/602.
- B. Thickness: Build single wythe walls to actual widths of masonry units, using units of widths indicated.
- C. Build chases and recesses to accommodate items specified in this and other Sections.
- D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- E. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures:
 - 1. Mix units from several pallets or cubes as they are placed.
- G. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- H. All masonry shall be laid true, level, plumb, and as indicated on Drawings.

3.6 TOLERANCES, GENERAL

- A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6 mm).
 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (13 mm) total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (13 mm) maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 3.1 m), or 1/2 inch (13 mm) maximum.
 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6.1 m), or 1/2 inch (13 mm) maximum.
 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 3.1 m), or 1/2 inch (13 mm) maximum.
 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6.1 m), or 1/2 inch (13 mm) maximum.
 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (13 mm) maximum.
 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.6 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch (13 mm); do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
 2. For exposed bed joints, do not vary from bed joint thickness of adjacent courses by more than 1/8 inch (3 mm).
 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6 mm).
 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.6 mm) from one masonry unit to the next.

3.7 LAYING MASONRY, GENERAL REQUIREMENTS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond. Do not use units with less than nominal 4 inches (102 mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified. Fill in solidly with masonry around built-in items.

- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill all cores in hollow CMU with grout.

3.8 MORTAR BEDDING AND JOINTING

- A. Lay masonry units as indicated in appropriate Section.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- C. Cut joints flush for masonry walls to receive plaster or other direct applied finishes (other than paint) unless otherwise indicated.
- D. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

3.9 MASONRY JOINT REINFORCEMENT

- A. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 - 1. Space reinforcement not more than 5/8 inch (16 mm) o.c.
 - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond opening in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T shaped units.
- D. Provide continuity at corners by using prefabricated L shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.10 ANCHORED VENEERS

- A. Ties and Anchors: Extend ties and anchors a minimum 1-1/2 inches (38 mm) into veneer but with at least a 5/8 inch (16 mm) cover on outside face.
- B. Provide not less than 1/2 inch (13 mm) of airspace between back of masonry veneer and face of masonry:
 - 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.11 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than 2 inches (51 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (914 mm) o.c. horizontally.
 - 3. Anchor masonry with anchors embedded in masonry joints and attached to structure.

- B. Anchor veneers to concrete masonry backup with masonry anchor ties and veneer ties as indicated on the Drawings. Comply with the following requirements:
 - 1. Embed anchor ties in masonry joints as indicated on Drawings.
 - 2. Fasten veneer ties to masonry backup through loops of anchor ties projecting from masonry surface.
 - 3. Space anchors ties as indicated, but not more than 12 inches (305 mm) o.c. vertically and 12 inches (305 mm) o.c. horizontally, with not less than one anchor for each square foot (10 anchors for each square meter) of wall area. Install additional anchors at openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

3.12 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and concrete backup with seismic masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
 - 3. BIA Technical Notes 28B recommends 2 inches (51 mm) of air space. Wider air spaces require closer tie spacing.
 - 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 - 5. Space anchors as indicated, but not more than 18 inches (457 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than one anchor for each 2 square feet (five anchors for each square meter) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm) 8 inches, around perimeter.
 - 6. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally with not less than one anchor for each 3-1/2 sq. ft. (0.3 m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm) 36 inches, around perimeter.

3.13 CONTROL AND EXPANSION JOINTS

- A. Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 - Joint Sealants, but not less than 3/8 inch (10 mm):
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.14 LINTELS

- A. Provide steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 24 inches (610 mm) for block size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

3.15 FLASHING, WEEPS, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
 - 1. Install flashing as follows unless otherwise indicated:
 - a. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on

- sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
- b. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (203 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (102 mm).
 - c. At lintels and shelf angles, extend flashing a minimum of 6 inches (152 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (152 mm) at ends and turn up not less than 2 inches (51 mm) to form end dams.
 - d. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant for application indicated.
 - e. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 - f. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
2. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- B. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
 - C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
 1. Use specified weep/vent products to form weep holes.
 2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
 3. Space weep holes 24 inches (610 mm) o.c. unless otherwise indicated.
 4. Retain last subparagraph above if weep holes other than plastic tubing or wicking are used. Retain first subparagraph below if plastic tubing or wicking is used.
 5. Space weep holes formed from plastic tubing or wicking material 16 inches (406 mm) o.c.
 6. Trim wicking material flush with outside face of wall after mortar has set.
 - D. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (51 mm), to maintain drainage.
 - E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" article.
 - F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents:
 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: The Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections:
 1. Special inspections according to Level C in TMS 402/602:
 - a. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

- b. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - c. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5,000 sq. ft. (465 sq. m) of wall area or portion thereof.
- E. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

3.17 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs:
 - 1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
 - 2. For burnished, glazed, or pre-finished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. After mortar is thoroughly set and cured, clean exposed masonry:
 - a. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
 - b. Test cleaning methods on sample wall panel; leave 1/2 of panel uncleaned for comparison purposes. Obtain the Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - c. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - d. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - e. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
 - f. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - g. Do not use acids on concrete masonry units.
 - h. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
- E. At completion of masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site:
 - 1. Comply with Construction Waste Management plan.

3.18 MASONRY WASTE DISPOSAL

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off the Owner's property.

3.19 WATER REPELLENT APPLICATION

- A. Cleaning shall be complete and accepted by the Architect, and wall surfaces shall be thoroughly dry prior to application.
- B. Apply water repellent in strict accordance with water repellent manufacturer's instructions.

END OF SECTION 04 05 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete block.
 - 2. Clay facing brick.
 - 3. Common brick.
 - 4. Mortar and grout.
 - 5. Reinforcement and anchorage.
 - 6. Flashings.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories: Dovetail slots for masonry anchors.
 - 2. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
 - 3. Section 03 30 00 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.
 - 4. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
 - 5. Section 06 10 00 - Rough Carpentry: Nailing strips built into masonry.
 - 6. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
 - 7. Section 07 62 00 - Roof-Related Sheet Metal: Through-wall masonry flashings.
 - 8. Section 07 84 13 - Penetration Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
 - 9. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- F. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale); 2023.
- G. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2023.
- H. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- I. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- J. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.

- K. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- M. {RSTEMP#1253}
- N. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- O. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- P. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- Q. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).
- T. UL (FRD) - Fire Resistance Directory; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Refer to Section 01 31 00 - Project Management and Coordination for additional requirements.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
 - 1. Include calculations or selections from the manufacturer's prescriptive design tables that indicate compliance with the applicable building code and project conditions.
 - 2. Include the design engineer's stamp or seal on each sheet of shop drawings.
- D. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
- E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
- G. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Installer's Qualification Statement.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Units: Furnish additional units of each type, size, and color combination equal to 1 percent of each type provided, with a minimum of 10 units..

1.6 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
 - 1. Maintain one copy of each document on project site.

- B. Fire Rated Assemblies: Comply with applicable code for UL (FRD) Assembly No. E119.
- C. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.
- E. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Handle and store unit masonry in protective cartons or trays. Do not remove from protective packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Concrete Masonry Units:
 - a. Acme Block & Brick: www.acmeblockandbrick.com.
 - b. Best Block: www.bestblock.com.
 - c. Boral Industries Company:
 - d. Concrete Products Group (The): www.concreteproductsgroup.com.
 - e. Omni Block, Inc.: www.omniblock.com.
 - f. Revels Block & Brick Company:
 - g. Texas Building Products, Inc.:
 - 2. Brick Masonry Units:
 - a. ACME Block & Brick: www.acmeblockandbrick.com.
 - b. Belden Brick: www.beldenbrick.com.
 - c. Endicott Clay Products Co: www.endicott.com.
 - d. General Shale, a subsidiary of Wienerberger AG: www.generalshale.com.
 - e. Interstate Brick: <https://interstatebrick.com>.
 - f. Meridian Brick LLC: www.meridianbrick.com.
 - 3. Reinforcement and Anchorage:
 - a. Blok-Lok Limited: www.blok-lok.com.
 - b. Hohmann & Barnard, Inc: www.h-b.com.
 - c. WIRE-BOND; www.wirebond.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 2. Fire Code:
 - a. Comply with applicable requirements of International Fire Code ICC (IFC).
 - 3. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: {RS#1253}.

- b. Sheet Steel: AWS D1.3/D1.3M.
- c. Stainless Steel: AWS D1.6/D1.6M.
- d. Steel: AWS D1.1/D1.1M.

2.3 CONCRETE MASONRY UNITS

- A. Burnished Concrete Block (CU6): Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth as indicated on Drawings.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other conditions indicated on Drawings.
 - a. Provide bullnose units for outside corners.
 - 3. Basis of Design: Blanca as manufactured by Upchurch Kimbrough.
- B. Burnished Concrete Block (CU8): Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 8 by 8 inches (400 by 200 mm) and nominal depth as indicated on Drawings.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other conditions indicated on Drawings.
 - 3. Basis of Design: Blanca as manufactured by Upchurch Kimbrough.

2.4 BRICK UNITS

- A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
 - 1. Basis of Design Product:
 - a. BK-1 - Field:
 - 1) Manufacturer: Upchurch Kimbrough.
 - 2) Color: Red.
 - 3) Finish: 530 Flashed.
 - 4) Size: Western King.
 - b. BK-2 - Field Burgundy:
 - 1) Manufacturer: ACME.
 - 2) Color: Burgundy.
 - 3) Finish: As selected by the Architect.
 - 4) Size: King.
 - c. BK-3 - Accent Dove Gray:
 - 1) Manufacturer: ACME.
 - 2) Color: Dove Gray.
 - 3) Finish: As selected by the Architect.
 - 4) Size: King.
 - d. BK-4 - Accent, Ebony:
 - 1) Manufacturer: ACME.
 - 2) Color: Ebony.
 - 3) Finish: As selected by the Architect.
 - 4) Size: King.
 - e. BK-5 - Accent, Glacier White:
 - 1) Manufacturer: ACME.
 - 2) Color: Glacier White.
 - 3) Finish: As selected by the Architect.
 - 4) Size: King.
 - 2. Special Shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
 - 3. Compressive Strength: As indicated on Drawings, measured in accordance with ASTM C67/C67M.

- B. Building (Common) Brick: ASTM C62, Grade SW; solid units.
 - 1. Nominal size: As indicated on Drawings.
 - 2. Compressive strength: As indicated on Drawings, measured in accordance with ASTM C67/C67M.

2.5 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

2.6 REINFORCEMENT AND ANCHORAGE

- A. Basis of Design Product:
 - 1. Products manufactured by Blok-Lok Limited.
 - 2. X-Seal Anchor manufactured by Hohmann & Barnard, Inc.
 - 3. Products manufactured by WIRE-BOND.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed billet bars; galvanized.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Single Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss or ladder.
 - 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 - 3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
- E. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss.
 - 2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
 - 3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
- F. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
 - 1. Type: Truss, with adjustable ties or tabs spaced at 16 in (406 mm) on center.
 - 2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
 - 3. Size: 0.1875 inch (4.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods and adjustable components of 0.1875 inch (4.8 mm) wire, width of components as required to provide not less than 5/8 inch (16 mm) of mortar coverage from each masonry face.
 - 4. Vertical Adjustment: Not more than 1 1/4 inches (32 mm).
 - 5. Insulation Clips: Provide clips at tabs or ties designed to secure insulation against outer face of inner wythe of masonry.
- G. Strap Anchors: Bent steel shapes, 1-1/2 inch (38 mm) width, 0.105 inch (2.7 mm) thick, 24 inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.
- H. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.
- I. Residential Wall Ties: Corrugated formed sheet metal, 7/8 inch (22 mm) wide by 0.05 inch (1.22 mm) thick, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to extend at least 1-1/2 inches (38 mm) into the veneer with at least 5/8 inch (16 mm) of mortar coverage from masonry face.

- J. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch (4.8 mm) thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in (32 mm).

2.7 FLASHINGS

- A. Metal Flashing Materials: Refer to Section 07 62 00 - Roof Related Sheet Metal.

2.8 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: As indicated on Drawings.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.
- D. Brick Units:
 - 1. Bond: As indicated on Drawings.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
 - 3. Mortar Joints: Concave.

3.5 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners, except for units laid in stack bond.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch (16 mm) mortar cover on each side.
- E. Lap joint reinforcement ends minimum 6 inches (150 mm).
- F. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches (400 mm) on center.
- G. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches (900 mm) horizontally and 24 inches (600 mm) vertically.
- H. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches (38 mm) with at least 5/8 inch (16 mm) mortar cover to the outside face of the anchor.

3.7 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
 - 1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up flashing ends at least 1 inch (25.4 mm), minimum, to form watertight pan at non-masonry construction.
 - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches (203 mm) minimum on vertical surface of backing:
 - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
 - 2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
 - 3. Terminate vertical leg of flashing into bed joint in masonry or reglet in concrete.
 - 4. Anchor vertical leg of flashing into backing with a termination bar and sealant.
 - 5. Apply cap bead of sealant on top edge of self-adhered flashing.
- C. Support flexible flashings across gaps and openings.

3.8 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.9 CUTTING AND FITTING

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.10 PARGING

- A. Dampen masonry walls prior to parging.
- B. Scarify each parging coat to ensure full bond to subsequent coat.
- C. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch (19 mm).
- D. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot (1 mm/m).
- E. Strike top edge of parging at 45 degrees.

3.11 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.
- D. Use non-metallic tools in cleaning operations.

3.12 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 04 20 00

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Miscellaneous masonry accessories.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 - 1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 - 2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
 - 1. Decorative CMUs, in the form of small-scale units.
 - 2. Pre-faced CMUs.
 - 3. Colored mortar.
 - 4. Weep holes/vents.
- D. Samples for Verification: For each type and color of the following:
 - 1. CMUs.
 - 2. Accessories embedded in masonry.

1.7 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
1. Build sample panels for each type of unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.
 2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
 3. Protect approved sample panels from the elements with weather-resistant membrane.
 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
- C. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 - 2. Density Classification: Normal weight unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
 - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of Portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91.
- F. Mortar Cement: ASTM C 1329.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- H. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints, less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- I. Aggregate for Grout: ASTM C 404.
- J. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
- L. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.

1. Interior Walls: Mill- galvanized, carbon steel.
 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 3. Wire Size for Side Rods: 0.148-inch diameter or as indicated on Drawings.
 4. Wire Size for Cross Rods: 0.148-inch diameter or as indicated on Drawings.
 5. Wire Size for Veneer Ties: 0.148-inch diameter or as indicated on Drawings.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units].
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.
 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008, Commercial Steel, with ASTM A 153, Class B coating.
 3. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch diameter, hot-dip galvanized steel.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, hot-dip galvanized steel.
 3. Corrugated Metal Ties: Metal strips not less than 7/8-inch-wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.075-inch-thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.
- D. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4-inch-thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153] [Epoxy coating 0.020 inch thick.

2.7 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of dimensions indicated.
- B. Post-installed Anchors: Torque-controlled expansion anchors or chemical/adhesive anchors unless otherwise indicated on Drawings.
 - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.

2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as indicated on Drawings. Include accessories, adhesives, primers, and seam tapes as applicable.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812, or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. For reinforced masonry, use Portland cement-lime mortar.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 1. For masonry below grade or in contact with earth, use Type M.
 2. For reinforced masonry, use Type S.
 3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 4. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, Table 1 or] paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi except where indicated on Drawings.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch or minus 1/4-inch.
 - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch.
 - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2-inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
 - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4-inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, or 1/2-inch maximum.
 - 5. For lines and surfaces do not vary from straight by more than 1/4-inch in 10 feet, 3/8-inch in 20 feet, or 1/2-inch maximum.
 - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
- C. Joints:
 - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch, with a maximum thickness limited to 1/2-inch.
 - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8-inch.
 - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch or minus 1/4-inch.
 - 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond, unless otherwise indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches or less on center unless otherwise indicated.
 - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch on exterior side of walls, 1/2-inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
 - 1. Provide an open space not less than inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches.

3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.

- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- G. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 31 20 00 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Cast stone masonry units and trim.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Steel embeds and lintels.
 - 2. Section 07 92 00 - Joint Sealants: Sealants for control and expansion joints.

1.3 REFERENCE STANDARDS

- A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2022.
- E. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- F. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2023.
- G. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method; 2017a.
- H. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
- J. ASTM C615/C615M - Standard Specification for Granite Dimension Stone; 2018, with Editorial Revision.
- K. ASTM C666/C666M - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing; 2015.
- L. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- M. ASTM C1194 - Standard Test Method for Compressive Strength of Architectural Cast Stone; current edition.
- N. ASTM C1195 - Standard Test Method for Absorption of Architectural Cast Stone; current edition.
- O. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.
- P. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Cast Stone.

- a. Dry Cast Concrete Products.
- b. Wet Cast Concrete Products.

1.5 SUBMITTALS

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Show fabrication and installation details for cast-stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces:
 - a. Include building elevations showing layout of units and locations of joints and anchors.
- C. Samples:
 - 1. For each color and texture of cast stone required, ten inches (250 mm) square in size.
 - 2. For each trim shape required, ten inches (250 mm) in length.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Standards: Comply with applicable requirements of the Cast Stone Institute Technical Manual.
- B. Manufacturer Qualifications: Manufacturer having minimum five (5) years' documented experience in the manufacture of cast stone units with sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute, the Architectural Precast Association, or the Precast/Prestressed Concrete Institute for Group A, Category AT.
- C. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- D. Source Limitations:
 - 1. Cast Stone: Obtain cast stone units from single source from single manufacturer.
 - 2. Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- E. Mockups:
 - 1. Build mockups to demonstrate aesthetic effects and establish quality standards for materials and execution:
 - a. Build mockup of typical wall area as shown on Drawings.
- F. Engineering Calculations: Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the work.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets:
 - 1. Lift with wide belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 - 2. Store cast stone units on wood skids or pallets with non-staining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

PART 2 PRODUCTS

2.1 CAST STONE MANUFACTURERS

- A. Manufacturers:
 - 1. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience

manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

- a. AHI.
- b. Advance Architectural Stone.
- c. Arris Stoneworks, Inc.
- d. Arriscraft, a division of General Shale.
- e. Dallas Cast Stone.
- f. Precision Development, inc.
- g. SiteWorks, Inc.
- h. Stone Castle Industries.
- i. United Commercial Cast Stone.

2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 CAST STONE MATERIALS

- A. Cast Stone Physical Properties:
 1. Compressive strength: ASTM C1194, 6,500 psi minimum for products at 28 days.
 2. Absorption: ASTM C1195, six percent (6%) maximum by the cold-water method or ten percent (10%) maximum by the boiling method for products at 28 days.
 3. Air content: ASTM C173/C173M or ASTM C231, for wet cast product shall be four percent to eight percent (4% - 8%) for units exposed to freeze-thaw environments. Air entrainment is not required for VDT products.
- B. Comply with ASTM C1364.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33/C33M; gradation and colors as needed to produce required cast-stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast-stone textures and colors.
- E. Color Pigment: ASTM C979/C979M, synthetic mineral oxide pigments or colored water reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- F. Admixtures:
 1. Use admixtures specified or approved in writing by Architect:
 - a. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 - b. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 - c. Air entraining admixture: ASTM C260/C260M. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of four to six percent (4% - 6%), except do not add to zero-slump concrete mixes.
 - d. Water reducing admixture: ASTM C494/C494M, Type A.
 - e. Water reducing, retarding admixture: ASTM C494/C494M, Type D.
 - f. Water reducing, accelerating admixture: ASTM C494/C494M, Type E.
- G. Reinforcement:
 1. Deformed steel bars complying with ASTM C615/C615M, Grade 60 (Grade 420). Use galvanized or epoxy coated reinforcement when covered with less than 1-1/2 inches (38 mm) of cast stone material:
 - a. Epoxy coating: ASTM A775/A775M.
 - b. Galvanized coating: ASTM A775/A775M.
- H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 304.

2.3 CAST STONE UNITS

- A. Cast Stone Units:
 - 1. Comply with ASTM C1364:
 - a. Units shall be manufactured using the vibrant dry tamp or wet cast method.
 - b. Units shall be resistant to freezing and thawing determined by laboratory testing according to ASTM C666/C666M, Procedure A, as modified by ASTM C1364.
- B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated:
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.
 - 4. Provide reveals for flashing reglets.
 - 5. Profiles and dimensions shall be in accordance with details shown on the Drawings.
- C. Fabrication Tolerances:
 - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch (3 mm).
 - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater, but in no case by more than 1/4 inch (6 mm).
 - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater.
 - 4. Location of Grooves, false joints, holes, anchorages, and similar features: Do not vary from indicated position by more than 1/8 inch (3 mm) on formed surfaces of units and 3/8 inch (10 mm) on unformed surfaces.
- D. Cure Units:
 - 1. Cure units in enclosed, moist curing room at 95 percent to 100 percent relative humidity and temperature of 100 degrees F (38 degrees C) for 12 hours or 70 degrees F (21 degrees C) for 16 hours.
 - 2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five (5) days at mean daily temperature of 70 degrees F (21 degrees C) or above.
 - b. No fewer than six (6) days at mean daily temperature of 60 degrees F (16 degrees C) or above.
 - c. No fewer than seven (7) days at mean daily temperature of 50 degrees F (10 degrees C) or above.
 - d. No fewer than eight (8) days at mean daily temperature of 45 degrees F (7 degrees C) or above.
- E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- F. Colors and Textures: To be selected by Architect.

2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- B. Dowels: 1/2 inch (12 mm) diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- C. Proprietary Acidic Cleaner:
 - 1. Standard strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer

and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials:

- a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1) Diedrich Technologies, Inc.
 - 2) EaCo Chem, Inc.
 - 3) PROSOCO, Inc.
- b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 SETTING CAST STONE IN MORTAR

- A. Unless otherwise indicated, install cast stone units with mortar joints to comply with requirements in Section 04 05 00 - Common Work Results for Masonry.
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances:
 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated:
 1. Set units with joints 3/8 to 1/2 inch (10 to 13 mm) wide unless otherwise indicated.
 2. Build anchors and ties into mortar joints as units are set.
 3. Fill dowel holes and anchor slots with mortar.
 4. Build concealed flashing into mortar joints as units are set.
 5. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
 6. Keep joints at shelf angles open to receive sealant.
- E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- G. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- H. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.
- I. Point joints with sealant to comply with applicable requirements in Section 07 92 00 - Joint Sealants:
 1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

- J. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure relieving joints; and at locations indicated:
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than 3/8 inch (10 mm).
 - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 07 92 00 - Joint Sealants.

3.3 SETTING ANCHORED CAST STONE WITH SEALANT FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances:
 - 1. Install anchors, supports, fasteners, and other attachments necessary to secure units in place.
 - 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- B. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.
- C. Fill anchor holes with sealant. Where dowel holes occur at pressure relieving joints, provide compressible material at ends of dowels.
- D. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed:
 - 1. Form open joint of width indicated, but not less than 3/8 inch (10 mm).
- F. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- G. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 07 92 00 - Joint Sealants.

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in ten feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- B. Variation from Level: Do not exceed 1/8 inch in ten feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning:

1. Clean cast stone as work progresses:
 - a. Remove mortar fins and smears before tooling joints.
 - b. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning:
 1. After mortar is thoroughly set and cured, clean exposed cast stone:
 - a. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
 - b. Test cleaning methods on sample; leave one (1) sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 - c. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - d. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - e. Clean cast stone by bucket and brush hand cleaning method described in BIA Technical Notes 20.
 - f. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 04 72 00

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SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Prefabricated building columns.
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 05 12 13 "Architecturally Exposed Structural Steel Framing".
 - 3. Section 05 31 00 "Steel Decking".
 - 4. Section 13 34 19 "Metal Building Systems".

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6 with flanges thicker than 1 1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents: The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges".
 - 2. AISC "Specification for Structural Steel Buildings," including the "Commentary" and the Supplements thereto, as issued.
 - 3. AISC "Specification for Architecturally Exposed Structural Steel".
 - 4. AISC's "Seismic Provisions for Structural Steel Buildings".
 - 5. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use".

6. AWS D1.1 Structural Welding Code.
7. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
8. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".
9. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
10. UL Fire Resistance Directory.

- B. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.5 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
1. Select and complete connections using schematic details indicated and AISC 360.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: System as indicated on Drawings.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand critical welds.
 8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. At full penetration welds, Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
1. Qualification Data: For qualified installer, fabricator, and testing agency.
 2. Welding certificates.
 3. Mill test reports for structural steel, including chemical and physical properties.

4. Product Test Reports: For the following:
 - a. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - b. Direct-tension indicators.
 - c. Tension-control, high-strength bolt-nut-washer assemblies.
 - d. Shear stud connectors.
 - e. Shop primers.
5. Source quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
 1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and re-lubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
 - 1. W-Shapes: 60 percent.
 - 2. Channels, Angles, M, S-Shapes: 60 percent.
 - 3. Plate and Bar: 25 percent.
 - 4. Cold-Formed Hollow Structural Sections: 25 percent.
 - 5. Steel Pipe: 25 percent.
 - 6. All Other Steel Materials: 25 percent.
- B. W-Shapes: Refer Structural General Notes.
- C. Channels, Angles, M, S-Shapes: Refer Structural General Notes.
- D. Plate and Bar: Refer Structural General Notes.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588, Grade 50.
- F. Cold-Formed Hollow Structural Sections: Refer Structural General Notes.
- G. Steel Pipe: Refer Structural General Notes.
 - 1. Weight Class: See Plans.
 - 2. Finish: Black except where indicated to be galvanized.
- H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers (All bolts located in Crawl Space): ASTM A 325, Type 1, heavy-hex steel structural bolts.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain or Mechanically deposited zinc coating, where required.
- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, See Anchor Bolt Schedule on Drawings for Grade.
 1. Configuration: Straight.
 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 3. Plate Washers: ASTM A 36 carbon steel.
 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 5. Finish:
 - a. General Condition – Plain
 - b. Crawl Space - Hot-dip zinc coating, ASTM A 153, Class C.
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- I. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Amscot Structural Products Corp.
 - b. Fluorocarbon Company Limited.
 - c. R.J. Watson Bridge & Structural Engineered Systems.
 - d. Seismic Energy Products, L.P.
 2. Mating Surfaces: PTFE and PTFE or mirror-finished stainless steel.
 3. Coefficient of Friction: Not more than 0.05.
 4. Design Load: Not less than 5,000 psi .
 5. Total Movement Capability: 2 inches.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer (General): Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- C. Primer (Crawl Space Steel): Tnemec Perimeprime Series 394.
- D. Galvanizing Repair Paint: SSPC-Paint 20.

2.4 GROUT

- A. Refer Section 03 30 00.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in final approved Shop Drawings.
 - 1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
 - 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other effects.
 - 3. Camber structural steel members where indicated. The camber specified is the camber that is measured in the field with the beam on its side so that the beam weight has no effect. During shipment and handling, cambered members shall be supported in a way that will not result in loss of camber.
 - 4. Camber tolerance
 - a. Beams 50 feet and less; plus or minus 1/2 inch.
 - b. Beams greater than 50 feet; plus or minus 1/2 inch, except tolerance can be increased 1/8 inch for each 10 feet or fraction thereof in excess of 50 feet.
 - c. Contact engineer for members outside specified camber tolerance. Provide engineer with a list of beam locations and actual measured camber amounts. Submit an engineered shoring plan, if requested, that will allow the beam to deflect to the horizontal position after concrete placement without overloading the framing below.
 - 5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
 - 6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."
- G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- H. Holes for Other Work: Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on approved shop drawings.

1. Provide threaded nuts welded to framing, and other specialty items as indicated to receive other work.
 2. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes by burning.
- I. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces. Base plates hole sizes for anchor bolts may be oversized to facilitate erection:
1. Bolts 3/4 inch to 7/8 inch diameter: 1/2 inch oversize.
 2. Bolts 1 inch to 1 1/2 inch diameter: 3/4 inch oversize.
 3. Bolts over 1 3/4 inch diameter: 1 inch oversize.
- J. Base Plate Washers: Sizes shall be as follows:
1. 3/4 inch diameter Bolts: 2 inch diameter x 1/4 inch thick
 2. 7/8 inch diameter Bolts: 2 1/2 inch diameter x 5/16 inch thick
 3. 1 inch diameter Bolts: 3 inch diameter x 3/8 inch thick
 4. 1 1/4 inch diameter Bolts: 3 inch diameter x 1/2 inch thick
 5. 1 1/2 inch diameter Bolts: 3 1/2 inch diameter x 1/2 inch thick
 6. 1 3/4 inch diameter Bolts: 4 inch diameter x 5/8 inch thick
 7. 2 inch diameter Bolts: 5 inch diameter x 3/4 inch thick
- K. Architecturally Exposed Structural Steel (AESS): Fabricate with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
 2. Comply with fabrication requirements, including tolerance limits, of AISC's "Specification for Architecturally Exposed Structural Steel" for architecturally exposed structural steel.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened, Pretensioned, or Slip critical as required or indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8, where required, for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing) excluding crawl space steel. Crawl space steel shall be primed regardless of whether it is to receive fireproofing.
 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- D. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- E. Crawl space steel to be primed to a DFT between 2.5 and 3.5 mils.
- F. Painting: Prepare steel and apply a one-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.
- G. GALVANIZING
- H. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels and shelf angles attached to structural steel frame and located in exterior walls.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Refer Section 01 45 23.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened, Pretensioned, or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 05 12 13 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes architecturally exposed structural-steel framing.
 - 1. Requirements in Section 05 12 00 "Structural Steel Framing".
- B. Related Sections:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 05 12 00 "Structural Steel Framing".

1.3 DEFINITIONS

- A. Architecturally Exposed Structural Steel: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. Category 1 AESS: AESS that is within 96 inches (2400 mm) vertically and 36 inches (900 mm) horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. Category 2 AESS: AESS that is within 20 feet (6 m) vertically and horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Indicate exposed surfaces and edges and surface preparation being used.
 - 6. Indicate special tolerances and erection requirements.
- B. Samples: Submit samples of AESS to set quality standards for exposed welds for Category 1 AESS.

1. Two steel plates, 3/8 by 8 by 4 inches (9.5 by 200 by 100 mm), with long edges joined by a groove weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches (9.5 by 200 by 200 mm), with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches (100 by 150 by 9.5 mm), welded to plate with a continuous fillet weld ground smooth and blended.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and fabricator.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1, P2, or P3 as applicable for exposure or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 1. Finish: Plain.

- B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

2.2 PRIMER

- A. Primer: Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: SSPC-Paint 20.

2.3 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 - 2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
 - 3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 - 4. Fabricate Category 1 and Category 2 AESS with exposed surfaces free of seams to maximum extent possible.
 - 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 - 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 - 7. Fabricate Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 - 8. Fabricate Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
 - 9. Seal-weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates for steel that is designated AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
 - 1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet (6 m) under any lighting conditions.
 - 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch (13 mm).
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch (3.2 mm) with a tolerance of 1/32 inch (0.8 mm) for Category 1 AESS.
- E. Bolt Holes: Cut, drill, mechanically (CNC) thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, mechanically (CNC) thermal cut, or punch holes perpendicular to steel surfaces.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.4 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 - 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 - 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 and 2 AESS is exposed to weather.
 - 4. Provide continuous welds of uniform size and profile where Category 1 and 2 AESS is welded.
 - 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus 0 inch (plus 1.5 mm, minus 0 mm) for Category 1 and Category 2 AESS.
 - 6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 - 7. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
 - 8. Make fillet welds for Category 1 and Category 2 AESS oversize and grind to uniform profile with smooth face and transition.

2.5 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 2. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - 3. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.6 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials.
 - 5. Galvanized surfaces.

- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 1. Erect Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 - 2. Erect Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- B. Do not use thermal cutting during erection.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pretensioned (TC), or Slip critical as indicated on Drawings.

- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
 - 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 - 2. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, and grind smooth.
 - 3. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency will not be responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 13

SECTION 05 21 00 – STEEL OPEN WEB JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. K-series steel joists.
 - 2. KCS-type K-series steel joists.
 - 3. K-series steel joist substitutes.
 - 4. LH- and DLH-series long-span steel joists.
 - 5. CJ-series composite steel joists.
 - 6. Joist girders.
 - 7. Joist accessories.
 - 8. Extended ends.
 - 9. Ceiling extensions.
 - 10. Bearing plates.
 - 11. Bridging.
 - 12. Side wall anchors.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete".
 - 2. Section 01 45 23 "Testing and Inspection Services"
 - 3. Section 04 20 00 "Unit Masonry".
 - 4. Section 05 12 00 "Structural Steel Framing".
 - 5. Section 05 31 13 "Steel Floor Decking".
 - 6. Section 05 31 23 "Steel Roof Decking".

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
- B. AWS D1.1 Structural Welding Code
- C. SJI "Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders".
- D. SDI "Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution".
- E. SSPC Steel Structures Painting Council Painting Manual.
- F. UL Fire Resistance Directory.
- G. ICBO Product Evaluation Reports.
- H. FM Roof Assembly Classifications.

- I. In the case of conflict between the Contract Documents and a reference standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
Review LEED requirements with Project Architect and edit as needed. References to LEED credits below MAY NOT be current.
- B. Shop Drawings:
 1. Include layout, designation, number, type, location, and spacing of joists.
 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 3. Indicate locations and details of bearing plates to be embedded in other construction.
 4. Shop drawings containing special joists shall be submitted with a design load summary for each special joist design. Load summary will be reviewed and returned with the joist submittal. Shop drawings containing special joists submitted without the specified load summary will be returned unchecked as an incomplete submittal. Shop drawings containing special joists shall be signed and sealed by the qualified professional engineer responsible for the design of the joists.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
 1. Qualification Data: For manufacturer.
 2. Welding certificates.
 3. Manufacturer certificates.
 4. Mill Certificates: For each type of bolt.
 5. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
- B. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- C. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.9 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and or masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
- B. Use ASD; data are given at service-load level.
- C. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - 1. Floor Joists: Vertical deflection of 1/360 of the span.
 - 2. Roof Joists: Vertical deflection of 1/360 of the span.
- D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.2 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.

2.3 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions and Extended Ends: Provide top chord extension or extended ends where shown on plans. Design for load indicated on plans.
- E. Camber joists according to SJI's Specifications unless noted otherwise.
- F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 LONG-SPAN STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on plan.
 - 1. Joist Type: Refer to Drawings.

2. End Arrangement: Refer to Drawings.
3. Top-Chord Arrangement: Refer to Drawings.

- B. Provide holes in chord members for connecting and securing other construction to joists.
- C. Camber long-span steel joists according to SJI's Specifications unless noted otherwise.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 JOIST GIRDERS

- A. Manufacture joist girders according to "Standard Specifications for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as indicated on plan.
 1. End Arrangement: Refer to Drawings.
 2. Top-Chord Arrangement: Refer to Drawings.
- B. Provide holes in chord members for connecting and securing other construction to joist girders.
- C. Camber joist girders according to SJI's Specifications unless noted otherwise.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.6 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.7 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint for interior exposure or Hot-dip zinc coat according to ASTM A 123/A 123M for exterior or weather exposure.
- C. Furnish ceiling extensions (where indicated), either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- D. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
Finish: Plain, uncoated.

- E. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish: Plain.
- F. Welding Electrodes: Comply with AWS standards.
- G. Galvanizing Repair Paint: ASTM A 780.
- H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.8 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 2 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications", "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written recommendations, and requirements in this Section.
- C. Before installation, splice joists delivered to Project site in more than one piece. Space, adjust, and align joists accurately in location before permanently fastening.
- D. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- E. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- F. Field weld joists to supporting steel bearing plates and framework as indicated on Drawings. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance, and quality of welds, and methods used in correcting welding work.

- G. Bolt joists to supporting steel framework using high-strength structural bolts as indicated on Drawings. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- H. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.

3.4 REPAIR AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
- C. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 1. Apply a compatible primer of same type as primer used on adjacent surfaces.
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 21 00

SECTION 05 31 13 - STEEL FLOOR DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Composite floor deck.
 - 2. Electrified cellular floor deck.
 - 3. Noncomposite form deck.
 - 4. Noncomposite vented form deck.
- B. Related Requirements:
 - 1. Section 01 45 23 "Testing and Inspection Services".
 - 2. Section 03 30 00 "Cast-in-Place Concrete".
 - 3. Section 05 12 00 "Structural Steel Framing".
 - 4. Section 05 21 00 "Steel Joist Framing"

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AWS D1.1 - Structural Welding Code
 - 2. AWS D1.3 – Structural Welding Code – Sheet Steel
 - 3. SDI – Design Manual for Composite Decks, Form Decks, Roof Decks, Cellular Metal Floor Deck with Electrical Distribution.
 - 4. SSPC – Painting Manual
 - 5. UL – Fire Resistance Directory
 - 6. ICBO – Product Evaluation Reports

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit the following informational submittals:
 - 1. Welding certificates.
 - 2. Product Certificates: For each type of steel deck.
 - 3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 4. Power-actuated mechanical fasteners.
 - 5. Evaluation Reports: For steel deck.
 - 6. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 COMPOSITE FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.
 - 6. DACS, Inc.
 - 7. Epic Metals Corporation.
 - 8. Marlyn Steel Decks, Inc.
 - 9. New Millennium Building Systems, LLC.
 - 10. Nucor Corp.; Vulcraft Group.
 - 11. Roof Deck, Inc.
 - 12. Verco Manufacturing Co.
 - 13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
 - 14. CSM Metal Deck

- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: As indicated in Structural General Notes.
 2. Profile Depth: As indicated on plan.
 3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 4. Span Condition: Triple span or more.

2.3 ELECTRIFIED CELLULAR FLOOR DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. CMC Joist & Deck.
 2. Consolidated Systems, Inc.; Metal Dek Group.
 3. Cordeck.
 4. HH Robertson Floor Systems; a CENTRIA company.
 5. Marlyn Steel Decks, Inc.
 6. New Millennium Building Systems, LLC.
 7. Nucor Corp.; Vulcraft Group.
 8. Verco Manufacturing Co.
 9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- C. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from single manufacturer.
- D. Electrified Cellular Floor Deck: Fabricate steel-sheet cellular floor-deck panels, consisting of a ribbed top section welded to a lower flat-bottom sheet with interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck" in SDI Publication No. 31. Fabricate deck to the minimum section properties, width of panel, number and area of cells per panel indicated, and the following:
1. Cellular Deck Type: Composite.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.
 3. Profile Depth: As indicated on plan.
 4. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
 5. Span Condition: Triple span or more.
 6. Factory punch holes, of size and arrangement indicated, into each deck cell at preset inserts and header duct locations.

2.4 NONCOMPOSITE FORM DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Cordeck.
 6. DACS, Inc.
 7. Marlyn Steel Decks, Inc.
 8. New Millennium Building Systems, LLC.

9. Nucor Corp.; Vulcraft Group.
 10. Roof Deck, Inc.
 11. Valley Joist; Subsidiary of EBSCO Industries, Inc.
 12. Verco Manufacturing Co.
 13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Form Deck: Fabricate ribbed-steel sheet non-composite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 80 minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard Gray.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G90 zinc coating.
 3. Profile Depth: As indicated on Plan.
 4. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 5. Span Condition: Triple span or more.
 6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.5 NONCOMPOSITE VENTED FORM DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Marlyn Steel Decks, Inc.
 6. New Millennium Building Systems, LLC.
 7. Nucor Corp.; Vulcraft Group.
 8. Roof Deck, Inc.
 9. Verco Manufacturing Co.
 10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Vented Form Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 80, G60 zinc coating.
 2. Profile Depth: As indicated on Plan.
 3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 4. Span Condition: Triple span or more.
 5. Side Laps: Overlapped or interlocking seam at Contractor's option.
 6. Vent Slot Area: Manufacturer's standard vent slots providing 1.5 percent open area.

2.6 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated on Drawings.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A 780.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Space and locate welds as indicated on Drawings.
 - 3. Weld Washers: Install weld washers at each weld location where deck is 22 gage or less.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch only with concrete filled decks.
 - 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Revise "Floor-Deck Closures" Paragraph below to suit Project. Sealing cellular deck openings, butt joints, and junctions with trench headers with tape is not included in this Section. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Electrified Cellular Floor Deck: Install cellular floor system with deck assembled from units indicated.
 - 1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Section 260539 "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.
- G. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.4 COMPOSITE FLOOR DECK INSTALLATION

- A. The composite steel deck shall be connected to the supporting steel beams by welding the shear/headed stud connectors through the deck as indicated in the drawings. Contractor to verify the attachment of the deck to the supporting member after the headed stud is welded. Improper amperage may cause burn through around the stud and the deck may not be adequately attached to the supporting deck.
- B. Where shear/headed stud connectors are not specified, the metal deck shall be attached to the supporting steel with 3/4-inch diameter puddle welds at a maximum spacing of 12 inches.
- C. Where the specified shear/headed stud connector spacing exceeds 12 inches, provide 3/4-inch diameter puddle welds between shear/headed stud connectors to maintain a maximum deck connection of 12 inches.
- D. Where deck units abut side to side or end to end over a supporting member provide 3/4-inch diameter puddle welds on each deck unit at a maximum spacing of 12 inches.
- E. Shear/Headed Stud Connectors: Field weld shear/headed stud connectors through deck to supporting frame according to AWS D1.1 and manufacturer's written instructions. Located connectors as indicated in the drawings. Remove and discard arc shields after welding shear/headed stud connectors.

3.5 DECK AND FLOOR DEFLECTION

- A. The metal deck is designed to deflect up to 3/4-inch.
- B. Uncambered steel beams are designed to be within code required deflection limits (Span/240). Cambered steel beams are designed to have a final deflected shape of less than 1/2-inch. Due to field tolerances and camber tolerances, these design limits may be slightly exceeded.
- C. The contractor shall account for any additional concrete required due to these deflected shape tolerances.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Refer Section 01 45 23.
- B. Remove and replace work that does not comply with specified requirements.
- C. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.7 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 31 23 - STEEL ROOF DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
 - 2. Acoustical roof deck.
 - 3. Noncomposite vented roof deck.
- B. Related Requirements:
 - 1. Section 01 45 23 "Testing and Inspection Services"
 - 2. Section 05 12 00 "Structural Steel Framing".

1.3 REFERENCES

- A. Comply with applicable provisions of the following specifications and documents. The latest adopted edition of all standards referenced in this section shall apply, unless noted otherwise.
 - 1. AWS D1.1 – Structural Welding Code
 - 2. AWS D1.3 – Structural Welding Code – Sheet Steel
 - 3. SDI – Design Manual
 - 4. SSPC – Painting Manual
 - 5. UL – Fire Resistance Directory
 - 6. ICBO – Product Evaluation Reports
 - 7. FM – Roof Assembly Classifications
- B. In the case of conflict between the Contract Documents and a referenced standard, the Contract Documents shall govern. In the case of a conflict between the Contract Documents and the Building Code, the more stringent shall govern.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.

- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer Section 01 45 23.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 - 2. Canam United States; Canam Group Inc.
 - 3. CMC Joist & Deck.
 - 4. Consolidated Systems, Inc.; Metal Dek Group.
 - 5. Cordeck.
 - 6. DACS, Inc.
 - 7. Epic Metals Corporation.
 - 8. Marilyn Steel Decks, Inc.

9. New Millennium Building Systems, LLC.
 10. Nucor Corp.; Vulcraft Group.
 11. Roof Deck, Inc.
 12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
 13. Verco Manufacturing Co.
 14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
 15. CSM Metal Deck
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 4. Deck Profile: As indicated on plan.
 5. Profile Depth: As indicated on plan.
 6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 7. Span Condition: Triple span or more.
 8. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Cordeck.
 6. DACS, Inc.
 7. Epic Metals Corporation.
 8. Marlyn Steel Decks, Inc.
 9. New Millennium Building Systems, LLC.
 10. Nucor Corp.; Vulcraft Group.
 11. Roof Deck, Inc.
 12. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 40 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 3. Deck Profile: As indicated in Structural General Notes.
 4. Cellular Deck Profile: As indicated in Structural General Notes.
 5. Profile Depth: As indicated in Structural General Notes.
 6. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.

7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated in Structural General Notes.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.
10. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
11. Sound-Absorbing Insulation: Manufacturer's standard pre-molded roll or strip of glass or mineral fiber.
 - a. Factory install sound-absorbing insulation into cells of cellular deck.

2.4 NONCOMPOSITE VENTED ROOF DECK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. ASC Profiles, Inc.; a Blue Scope Steel company.
 2. Canam United States; Canam Group Inc.
 3. CMC Joist & Deck.
 4. Consolidated Systems, Inc.; Metal Dek Group.
 5. Marlyn Steel Decks, Inc.
 6. New Millennium Building Systems, LLC.
 7. Nucor Corp.; Vulcraft Group.
 8. Roof Deck, Inc.
 9. Verco Manufacturing Co.
 10. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Noncomposite Vented Roof Deck: Fabricate ribbed- and vented-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, and with the following:
 1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 40, G60 zinc coating.
 2. Profile Depth: As indicated in Structural General Notes.
 3. Design Uncoated-Steel Thickness: As indicated in Structural General Notes.
 4. Span Condition: Triple span or more.
 5. Side Laps: Overlapped or interlocking seam at Contractor's option.
 6. Vent Slot Area: Manufacturer's standard vent slots providing 1-1/2.

2.5 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth unless otherwise indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A 780.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
 1. Fasteners shall provide diaphragm shear and uplift resistance equal to or greater than welding indicated herein and on Drawings.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 1. Weld Diameter: As indicated on Structural Plans.
 2. Weld Spacing: As indicated on Structural Plans.
 3. Weld Washers: Install weld washers at each weld location if deck gauge is lighter than 22 gauge.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals shown on Structural Plans:
 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 2. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
 1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: See Section 01 45 23.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD FORMED METAL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Load bearing wall framing.
 - 2. Exterior non-load bearing wall framing.
 - 3. Floor joist framing.
 - 4. Roof rafter framing.
 - 5. Ceiling joist framing.
 - 6. Soffit framing.
 - 7. Accessories necessary for a complete installation.
- B. Related Sections:

1.3 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- B. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).
- C. AISI S200 - North American Standard for Cold-Formed Steel Framing - General Provisions; 2012.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- G. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2023.
- H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- I. ASTM C1513 - Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections; 2018.
- J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- K. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- L. ASTM E1190 - 2021 Edition, November 15, 2021 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; 2021 Edition, November 15, 2021.
- M. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- N. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: The Contractor shall engage a qualified professional engineer, licensed in the State in which the Project is located, to design cold formed steel framing.

- B. Structural Performance: Delegated design engineer shall provide cold-formed steel framing designs capable of withstanding all code required design loads within limits and under conditions indicated on the construction documents and within this Specification:
1. Design Loads: Designs shall be capable of withstanding the worst case loading as indicated on the structural drawings, and/or as required by the locally adopted Building Code. The design shall cover the worst case loading in all instances.
 2. Coordinate the requirements on the structural and architectural Drawings with the requirements of this Section. If a conflict exists, notations on the structural drawings take precedence.
 3. The following document governs the Work, except where more restrictive items are specified:
 - a. AISI Design of Cold-Formed Steel Structural Members Wind Load:
 - 1) Minimum design loads for exterior and/or load bearing and/or soffit applications:
 - (a) As required by code officials having jurisdiction.
 - (b) Deflection: 1/600 for clear simple spans.
 - (c) Deflection: 1/300 for cantilever conditions and roof parapets.
 - (d) Gauge: 16 gauge minimum, unless noted otherwise.
 - 2) Minimum design loads for interior and/or exterior suspended furr-downs with a maximum vertical drop on either side of 5 feet or greater:
 - (a) As required by Authorities Having Jurisdiction (AHJ).
 - (b) Deflection: 1/600 for clear simple spans.
 - (c) Deflection: 1/300 for cantilever conditions and roof parapets.
 - (d) Gauge: 20 gauge minimum, unless noted otherwise.
 4. It is a common practice for studs thinner than 20 gauge to be crimped and/or ribbed to increase the strength of the overall stud cross section for various loading applications. These studs are typically noted by manufacturer as "equivalent" to a thicker gauge. These "equivalent" type studs are not allowed in a vertically suspended application with greater than 60 inch (1524 mm) of vertical wall drop, 20 gauge is the minimum thickness allowed for these applications.
 5. Welding qualifications: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."
 6. Studs, tracks, channels, and other light gauge framing members shall conform to requirements of ASTM C955.
 7. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.
 8. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F (87 degrees C).
 9. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure:
 - a. Upward and downward movement of 1-1/2 inch (38 mm).
 10. Design exterior non-load bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold Formed Steel Framing Design Standards:
1. Wall studs: AISI S211.
 2. Headers: AISI S212.
 3. Lateral design: AISI S213.

1.5 SUBMITTALS

- A. Product Data: Technical data for cold formed steel framing product and accessories including factory applied primers.
- B. Shop Drawings:
 - 1. Submit layout, spacings, sizes, thickness, and types of cold formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners:
 - a. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - b. Shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.
- C. Supplementary Design Details: The general design is presumed adequate to permit compliance with the specified performance. Provide engineering calculations and shop drawings to supplement the general design. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas. Calculations and shop drawings must show design will withstand wind loading commiserate with class and rating of the Project.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Welding qualifications:
 - a. Qualify procedures and personnel according to the following:
 - 1) AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
 - 2) CCFSS Technical Bulletin: "AISI Specification Provision for Screw Connections."
 - 2. Comply with AISI North American Specification for the Design of Cold Formed Steel Structural Members and Standard for Cold Formed Steel Framing - General Provisions:
 - a. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
 - 3. Fire Resistance Ratings: ASTM E119; testing by a UL. Identify products with appropriate markings of applicable testing agency. Indicate design designations from UL Fire Resistance Directory.
 - 4. Installer qualifications: Company specializing in the installation of cold formed metal framing components with minimum 5 years' documented experience.
 - 5. Install system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 - 6. Install system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 - 7. Mill certificates signed by steel sheet producer indicating steel sheet complies with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and galvanized-coating thickness.
- B. Professional Engineer Qualifications:
 - 1. A professional engineer who is legally qualified to practice in the State of Texas and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold formed metal framing that are similar to those indicated in material, design, and extent:
 - a. Engineering Responsibility: Preparation of shop drawings, design calculations, and structural data.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. CEMCO: www.cemcosteel.com.
 - 2. Clarkwestern Dietrich Building Systems, LLC: www.clarkdietrich.com.
 - 3. Consolidated Fabricators Corp.: www.confabbd.com.
 - 4. SCAFCO Steel Stud Company, a subsidiary of the Stone Group of Companies: www.scafco.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 LOAD BEARING WALL FRAMING

- A. Steel Studs:
 - 1. C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
 - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1-5/8 inch (41 mm).
 - c. Section Properties: As indicated on Drawings.
- B. Steel Track:
 - 1. U-shaped steel track, of web depths indicated, unpunched, with straight flanges:
 - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1-1/4 inch (32 mm).
- C. Steel Box or Back to Back Headers:
 - 1. C-shape used to form header beams, of web depths indicated, unpunched, with stiffened flanges:
 - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1-5/8 inch (41 mm).
- D. Steel Single or Double L Headers:
 - 1. L-shapes used to form header beams, of web depths indicated:
 - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Top Flange Width: 1-5/8 inch (41 mm).
 - c. Section Properties: As indicated on Drawings.

2.3 EXTERIOR NONLOAD BEARING WALL FRAMING

- A. Steel Studs:
 - 1. C-shaped steel studs, of web depths indicated, punched, with stiffened flanges:
 - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1-5/8 inch (41 mm).
 - c. Section Properties: As indicated on Drawings.
- B. Steel Track:

1. U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - a. Minimum Base Metal Thickness: 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1-1/4 inch (32 mm).
- C. Vertical Deflection Clips:
 1. Head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web:
 2. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Clarkwestern Dietrich Building Systems, LLC: www.clarkdietrich.com.
 - 2) SCAFCO Corporation: www.scafc.com.
 - 3) Simpson Strong-Tie Company, Inc.: www.strongtie.com.
 - 4) Steeler, Inc.: www.steeler.com.
 - 5) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - (a) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - D. Single Deflection Track:
 1. Single, deep leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure:
 - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
 - E. Double Deflection Tracks:
 1. Double, deep leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges:
 - a. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure:
 - 1) Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 0.0966 inch (2.45 mm).
 - 2) Flange width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
 2. Inner Track: Of web depth indicated:
 - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm), 0.0538 inch (1.37 mm), 0.0677 inch (1.72 mm), and 2 inches (51 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for one story structures and 1 inch (25 mm) plus twice the design gap for other applications.
 - F. Drift Clips: Bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 CEILING JOIST FRAMING

- A. Steel Ceiling Joists:
 1. C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges:
 - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).

- b. Flange Width: 2 inches (51 mm).

2.5 SOFFIT FRAMING

- A. Exterior Soffit Frame:
 - 1. C-shaped steel sections, of web depths indicated, with stiffened flanges:
 - a. Minimum Base Metal Thickness: 0.0428 inch (1.09 mm).
 - b. Flange Width: 1-5/8 inch (41 mm) minimum.

2.6 FRAMING ACCESSORIES

- A. Fabricate steel framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of appropriate thickness and configuration, unless otherwise indicated:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.
- C. Anchors, Clips, and Fasteners:
 - 1. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot dip process according to ASTM A123/A123M.
 - 2. Expansion anchors: Fabricated from corrosion resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
 - 3. Power actuated anchors: Fastener system of type suitable for application indicated, fabricated from corrosion resistant materials, with allowable load capacities calculated, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
 - 4. Mechanical fasteners:
 - a. ASTM C1513, corrosion resistant coated, self-drilling, self-tapping, steel drill screws:
 - 1) Head type: Low profile head beneath sheathing.
 - 5. Welding electrodes: Comply with AWS standards.
- D. Miscellaneous Materials:
 - 1. Galvanizing Repair Paint: SSPC-Paint 20 or ASTM C780.
 - 2. Non-Metallic, Non-Shrink Grout: Premixed, non-metallic, non-corrosive, non-staining grout containing selected silica sands, portland cement, shrinkage compensating agents, and plasticizing and water reducing agents, complying with ASTM C1107/C1107M, with fluid consistency and 30 minute working time.
 - 3. Shims: Load bearing, high density multimonomer plastic, and non-leaching; or of cold formed steel of same grade and coating as framing members supported by shims.
 - 4. Sealer Gaskets: Closed cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

- A. Fabricate cold formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI specifications and standards, manufacturer written instructions, and specified requirements:
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted:
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to shop drawings, with screw penetrating joined members by no fewer than three (3) exposed screw threads.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances:
 - 1. Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch (3 mm) in 10 feet (3 m) (1:960) and as follows:
 - a. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - b. Squareness: Fabricate each cold formed steel framing assembly to a maximum out of square tolerance of 1/8 inch (3 mm).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

3.2 PREPARATION

- A. Before sprayed fire resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire resistive materials, remove only as much as necessary to complete installation of cold formed framing without reducing thickness of fire resistive materials below required thickness to obtain fire resistance rating indicated. Protect remaining fire resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 ERECTION

- A. General:
 - 1. Track Anchors: Install anchors maximum 4 feet (1.2 m) on center; design anchors and spacing to carry live, dead, and wind loads.
 - 2. Track Splices: Provide channel inserts or weld track splices.
 - 3. Erection: Install members plumb, level, and in a true plane.
 - 4. Fastenings: Make assembly rigid and secure, with welds free of voids and burnouts.
- B. Install metal framing systems in accordance with stud manufacturer's printed instructions.
- C. Runner Tracks:
 - 1. Install continuous tracks sized to match studs.

2. Align tracks accurately to layout at base and tops of studs.
 3. Secure tracks as recommended by stud manufacturer, except do not exceed 24 inches (610 mm) on center for nail or power-driven fasteners, nor 16 inches (406 mm) on center for other types of attachment.
 4. Provide fasteners at corners and ends of tracks.
 5. Tracks shall be anchored to structural steel prior to installing sprayed on insulation.
 6. Provide deflection track (DT), at top of stud walls at floor or roof above, typically. Allow for 1/2 inch (13 mm) movement of primary structure. Do not attach studs directly to deflection track.
 7. Vertical deflection clips: Provide manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure.
- D. Secure studs to top track and bottom runner track by means of approved self-drilling screws or welding at both inside and outside flanges of 14 gauge or heavier material. Screws and welds shall be of sufficient size to insure strength of connection. All welding shall comply with American Welding Society "Specification for Welding Sheet Steel in Structures."
- E. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- F. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure. Use Zee clips as specified above. Weld "Z" shaped clips to structural members as shown on drawings. Maximum 2 feet on center vertical.
- G. Install supplementary framing, blocking, and bracing in the metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer's recommendations and industry standards in each case, considering the weight or loading resulting from the item supported.
- H. Frame wall openings with extra studs, equal to the number of studs interrupted by wall openings, placed at each side of wall openings. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with shoes or by welding, and space jack studs same as full-height studs of the wall. Secure stud system all around to wall opening frame in the manner indicated.
- I. Install bracing/bridging in accordance with manufacturer's instructions and design conditions.
- J. Touch up field welds and damaged galvanized coating, except touch up of field cut studs is not required.
- K. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- L. Install horizontal stiffeners in stud system, space (vertical distance) at no more than 54 inch (1372 mm) on center. Weld at each intersection.

3.4 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track:
1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inch (38 mm).
 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel stud sections as indicated on shop drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls:
1. Joist Spacing: 16 inches (406 mm).

- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on shop drawings:
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on shop drawings. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold down angles, anchors, and fasteners, to provide a complete and stable joist framing assembly.

END OF SECTION 05 40 00

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bollards.
 - a. Door Device Mounting Post.
 - b. Metal Pipe Bollards, Fixed and Removable.
 - c. Pipe/downspout guards.
 - 2. Steel framing and supports for ceiling-hung toilet partitions.
 - 3. CMU Partition Head Supports.
 - 4. Downspout boots.
 - 5. Equipment framing and supports.
 - 6. Equipment guards.
 - 7. Folding metal gates.
 - 8. Ladder safety cages.
 - 9. Loose steel lintels.
 - 10. Metal ladders.
 - 11. Miscellaneous steel, including steel angle corner guards, steel edgings, and loading dock edge angles.
 - 12. Shelf angles.
 - 13. Slotted channel framing.
 - 14. Accessories as necessary for complete installation.
- B. Related Sections:

1.3 REFERENCE STANDARDS

- A. 29 CFR 1910.25 - Occupational Safety and Health Standards - Stairways; Current Edition.
- B. 2012 TAS - Texas Accessibility Standards; 2012.
- C. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- D. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- E. ASTM A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application; 2020.
- F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- H. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

- K. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- L. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- M. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
- N. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014 Edition, September 1, 2014
- O. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014 Edition, September 1, 2014
- P. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- Q. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- R. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- S. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- T. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- U. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- V. ASTM A741 - Standard Specification for Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail; 2011.
- W. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- X. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates; 2015 (Reapproved 2021).
- Y. ASTM A793 - Standard Specification for Rolled Floor Plate, Stainless Steel; 1996.
- Z. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- AA. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- BB. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar; 2023.
- CC. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- DD. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- EE. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- FF. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.
- GG. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- HH. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.

- II. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.
- JJ. ASTM B632/B632M - Standard Specification for Aluminum-Alloy Rolled Tread Plate; 2018.
- KK. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- LL. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- MM. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- NN. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- OO. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- PP. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- QQ. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.
- RR. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.
- SS. ASTM F738M - Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs; 2002 Edition, April 10, 2002
- TT. ASTM F836M - Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric); 2020 Edition, May 1, 2020.
- UU. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- VV. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- WW. ASTM F2329/2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; 2015.
- XX. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- YY. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- ZZ. {RSTEMP#1253}
- AAA. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- BBB. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- CCC. MFMA-4 - Metal Framing Standards Publication; 2004.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Structural Performance of Ladders: Provide ladders and landings capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Structural Performance:
 - 1. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the

materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:

- a. All deadloads.
 - b. 500 pound live load placed on the countertop and vanity.
 - c. Deflection at Midspan: $L/1000$ times span or 1/8 inch whichever is less.
- D. Thermal Movements:
1. Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
 - a. Temperature change (range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 SUBMITTALS

- A. Product Data: Submit data for miscellaneous metal fabrications and paint, coatings, and grout accessories.
- B. Shop Drawings:
 1. Submit shop drawings detailing the fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items:
 - a. For installed products indicated to comply with design loads, include structural analysis data, for information only, signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Welding Certificates.
- E. Paint Compatibility Certificates: Submit manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Building Code: Comply with applicable requirements of the IBC for metal fabrications.
 2. Welding: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M Structural Welding Code – Steel.
 - b. {RS#1253} Structural Welding Code - Aluminum.
 - c. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
 - d. AWS D1.6/D1.6M Structural Welding Code - Stainless Steel.
 - e. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this work for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated in material, design, and extent.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store metal fabrications in a dry, well ventilated, weathertight place. Deliver and handle to prevent any type of damage to the fabricated work.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Welding shall comply with AWS D1.1/D1.1M.

2.2 MATERIALS

- A. Metal Surfaces, General:
 - 1. Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
 - 2. Slotted Channel Framing: Cold formed metal box channels (struts) complying with MFMA-4.
 - a. Size of Channels: 1-5/8 inches by 1-5/8 inches (41 mm by 41 mm).
 - b. Material: Galvanized steel ASTM A653/A653M, commercial steel, Type B, with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
 - c. Cold Formed Metal Channels: Flange edges returned toward web and with 9/16 inch (14.3 mm) wide slotted holes in webs at 2 inches (51 mm) o.c.
 - d. Width of Channels: 1-5/8 inches (41 mm).
 - e. Depth of Channels: As indicated on Drawings.
 - f. Metal and Thickness: Galvanized steel complying with ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108 inch (2.8 mm) nominal thickness.
 - g. Finish: Hot dip galvanized after fabrication.
 - 3. Fasteners: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - a. Provide stainless steel fasteners for fastening aluminum.
 - b. Provide stainless steel fasteners for fastening stainless steel.
 - c. Provide stainless steel fasteners for fastening nickel silver.

- d. Provide bronze fasteners for fastening bronze.
 - e. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563/A563M; and, where indicated, flat washers.
 - f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A325/ASTM A325M, Type 3; with hex nuts, ASTM A563/A563M, Grade C3 (ASTM A563M, Class 8S3); and, where indicated, flat washers.
 - g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F1554 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy.
 - h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M; and, where indicated, flat washers.
 - 1) Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
 - i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - j. Cast in Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.
 - k. Post Installed Anchors:
 - 1) Material for Interior Locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2) Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) or Group 2 (A4) stainless steel bolts, ASTM F593 ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
 - l. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts
- B. Aluminum:
- 1. Aluminum Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
 - 2. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
 - 3. Aluminum Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
 - 4. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- C. Bronze:
- 1. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (extruded architectural bronze).
 - 2. Bronze Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).
 - 3. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- D. Cast Iron:
- 1. Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- E. Nickel:
- 1. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

2. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).
- F. Stainless Steel:
1. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.
 2. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.
 3. Rolled Stainless Steel Floor Plate: ASTM A793.
- G. Steel:
1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
 2. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
 3. Steel Tubing: ASTM A500/A500M, cold formed steel tubing.
 4. Rolled Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- H. Zinc Coated Steel Wire Rope: ASTM A741:
1. Wire Rope Fittings: Hot dip galvanized steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- I. Abrasive Surface Floor Plate:
1. Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel:
 - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1) IKG Industries, a division of Harsco Corporation.
 - 2) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
- J. Fasteners:
1. Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required:
 - a. Provide stainless steel fasteners for fastening aluminum.
 - b. Provide stainless steel fasteners for fastening stainless steel.
 - c. Provide stainless steel fasteners for fastening nickel silver.
 - d. Provide bronze fasteners for fastening bronze.
 - e. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A with hex nuts, ASTM A563/A563M and, where indicated, flat washers.
 - f. Steel Bolts and Nuts: Regular hexagon head bolts, ASTM F3125/F3125M, Type 3 with hex nuts, ASTM A563/A563M, Grade C3 and, where indicated, flat washers.
 - g. Stainless Steel Bolts and Nuts: Regular hexagon head annealed stainless steel bolts, ASTM F593 with hex nuts, ASTM F594 and, where indicated, flat washers; alloy.
 - h. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M and, where indicated, flat washers:
 - 1) Hot dip galvanize or provide mechanically deposited zinc coating where item being fastened is indicated to be galvanized.
 - i. Anchors: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - j. Post Installed Anchors: Torque controlled expansion anchors or chemical anchors

- 1) Material for interior locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2) Material for exterior locations and where stainless steel is indicated: Alloy; Group 1 (A1) or Group 2 (A4), ASTM F593, and nuts, ASTM F594.
 - k. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F2329/2329M.
 - l. Slotted Channel Inserts: Cold-formed, hot-dip galvanized steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee head bolts, complete with washers and nuts, all zinc plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.
- K. Miscellaneous Materials:
1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
 2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
 3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
 4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
 5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
 6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
 7. Non-shrink, Non-Metallic Grout: Factory packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 8. Concrete Materials and Properties: Composed of ASTM C150/C150M Type I Portland cement, ASTM C33/C33M sand and coarse aggregates and potable water to produce a low slump mix suitable for placement. Grade coarse aggregate from 1/8 inch with at least 95 percent passing a 3/8-inch sieve and not more than 10 percent passing a No. 8 sieve. Fill shall be proportioned to provide a minimum 28-day compressive strength of 3,000 psi (20 MPa).

2.3 FABRICATION

- A. Shop Assembly:
1. Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation:
 - a. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
 - b. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - c. Form exposed work with accurate angles and surfaces and straight edges.

- d. Weld corners and seams continuously to comply with the following:
 - 1) Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2) Obtain fusion without undercut or overlap.
 - 3) Remove welding flux immediately.
 - 4) At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
 - e. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
 - f. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
 - g. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
 - h. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - i. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 inch by 1-1/2 inches (3.2 mm by 38 mm), with a minimum 6 inch (150 mm) embedment and 2 inch (50 mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.
 - j. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.
2. Miscellaneous Framing and Supports: Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to framing and supports for elevator hoistway beams, elevator sills, overhead lobby door frames, sliding doors, countertop and vanities, ceiling hung toilet compartments, and tube framing for partial height walls, CMU partition head supports, mechanical and electrical equipment.
- a. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1) Fabricate units from slotted channel framing where indicated.
 - 2) Furnish inserts for units installed after concrete is placed.
 - b. Operable Partition Supports: Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
 - c. Framing for Ceiling Hung Toilet Compartments: Provide framing for ceiling hung toilet compartments, coordinated with the partitions and including provisions for partition anchorage as required to sustain imposed loads and to limit deflections to $L/360$ between hangers, fabricated from the following:
 - 1) Structural Steel Shapes, Plates and Bars: ASTM A36/A36M.
 - 2) Modular Structural Framing System: ASTM A569; modular, structural quality steel preformed U-channel framing system with continuous open slot prepared to receive attachment nuts, bolts, straps, threaded rods, beam clamps, hanger rods support brackets and other accessories. Provide corrosion resistant finish.

- 3) Provide steel rods, 1/2 inch (13 mm) diameter, spaced at maximum 36 inches (900 mm) o.c. Thread rods to receive anchor and stop nuts. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
- 4) Coordinate installation with toilet compartment manufacturer's written instructions and recommendations.
- d. CMU Partition Head Supports: Fabricate supports from 4 inch x 4 inch x 1/4 inch by 36 inch (100 mm by 100 mm by 6 mm by 900 mm) long structural steel angles. Drill supports a maximum of 12 inches (300 mm) o.c. to receive expansion bolts.
- e. Galvanize miscellaneous framing and supports at exterior locations; prime paint miscellaneous framing and supports at interior locations.

2.4 BOLLARDS

- A. Door Device Mounting Bollard:
 1. Description: Mounting post for card reader and door activation button:
 2. Basis of Design: "Model 22PE1-2NIP-01-CRS" as manufactured by Pedestal PRO.
 3. Material: Stainless Ste
 4. Finish: Powder Coat.
 5. Accessories to be included for installation:
 - a. Description: Card Reader Outdoor Protection.
 - b. Basis of Design: "Model 456HOO-HID-01-CRS" as manufactured by Pedestal Pro.
 - c. Finish: Powder Coat.
- B. Pipe Bollards:
 1. Fabricate metal bollards from Schedule 40 steel pipe or 1/4 inch (6.4 mm) wall thickness rectangular steel tubing.
 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
 4. Where bollards are to be installed on structural slab or existing paving:
 - a. Fabricate bollards with 3/8 inch (9.5 mm) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch (19 mm) anchor bolts.
 - b. Where bollards are anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
 5. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4 inch (6.4 mm) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

2.5 DOWNSPOUT BOOTS

- A. Basis of Design:
 1. Model N-6616CX manufactured by J.R. Hoe & Sons,
- B. Material: Cast Iron complying with ASTM A48/A48M Class 30 CI.
- C. Angle: 90 degrees.
- D. Size:
 1. Inlet: 6 by 6 inches.
 2. Overall Height: 16 inches.
 3. Outlet: 5-7/8 inches.

2.6 FOLDING METAL GATES

- A. Description: Steel scissor-type gate.
 1. Type: Scissor-Type single, pair, and door gate.
 2. Finish: Galvanized Steel.

3. Webbing: Heavy-duty, 14 gauge, U-channel riveted back-to-back with zinc-plated rivets.
4. Frame: Heavy-Duty, 12 Gauge, 1-1/2 inch x 1-1/2 inch Vertical Angle Frame.
5. Casters: Solid Steel.
6. Locking:
 - a. Single Gate shall include heavy-duty 12 gauge zinc-plated angle locking bar with 3/16 inch padlock hasp. Lock shall be on right unless noted otherwise.
 - b. Paired Gate shall meet in middle and lock with 3/16 inch padlock hasp.
 - c. Door Gate shall include heavy-duty 12 gauge zinc-plated angle locking bar with 3/16 inch padlock hasp which shall lock to right wall unless noted otherwise.
7. Mounting: Can be mounted to wall, door frame, or attached to free standing.
8. Size:
 - a. Height: 8 feet, unless noted otherwise.
 - b. Width: As required.
9. Basis of Design: "Heavy-Duty Folding Gates" manufactured by Illinois Engineered Products.

2.7 GUARDS

- A. Equipment Guards:
 1. Provide metal tube framing for security and public safety around equipment where indicated on Drawings.
 2. Fabricate equipment guards from 1-1/2 inch O.D. steel tube.
 3. Finish Paint Federal Yellow or add stripe caution reflective tape.
- B. Pipe and Downspout Guards:
 1. Fabricate pipe and downspout guards from 3/8 inch (9.5 mm) thick by 12 inch (300 mm) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with two-inch (50 mm) clearance between pipe and pipe guard. Drill each end for two (2) 3/4-inch (19 mm) anchor bolts.
 2. Galvanize and prime pipe, downspout guards.

2.8 LADDERS

- A. Comply with ANSI A14.3. For elevator pit ladders, comply with ASME A17.1/CSA B44
- B. Aluminum Ladders:
 1. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. ACL Industries, Inc.
 - b. Alco-Lite Industrial Products.
 - c. Halliday Products.
 - d. O'Keeffe's Inc.
 - e. Precision Ladders, LLC.
 - f. Royalite Manufacturing, Inc.
 - g. Thompson Fabricating, LLC.
 2. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
 3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.
 4. Rungs: Extruded aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces.
 5. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.

6. Provide platforms as indicated fabricated from pressure locked aluminum bar grating, supported by extruded aluminum framing. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
 7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted aluminum brackets.
 8. Provide minimum 72 inch (1830 mm) high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.
- C. Self-Closing Ladder Gate (LG):
1. Basis of Design: Safe-T Self Closing Ladder Gate as manufactured by Guardian.
 2. SKU Number: 10798.
 3. Size: 36 inches Long by 7 inches High.
 4. OSHA Compliant.

2.9 LADDER SAFETY CAGES

- A. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless steel fasteners.
1. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.
 2. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless steel fasteners unless otherwise indicated.
- B. Aluminum Ladder Safety Cages:
1. Primary Hoops: 1/4 inch by 4 inch (6.4 mm by 100 mm) flat bar hoops.
 2. Secondary Intermediate Hoops: 1/4 inch by 2 inch (6.4 mm by 50 mm) flat bar hoops.
 3. Vertical Bars: 1/4 inch by 2 inch (6.4 mm by 50 mm) flat bars secured to each hoop.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Provide steel framing and supports necessary to complete the work and which are not a part of the structural framework, including but not limited to the following:
1. Ceiling-hung toilet compartments.
 2. CMU partition head.
 3. Coiling overhead door.
 4. Coiling overhead grille.
 5. Equipment.
 6. Loose steel lintels.
 7. Operable partition supports.
 8. Shelf angles.
- B. Fabrication, General:
1. Fabricate from steel shapes, plates, and bars of welded construction unless otherwise indicated.
 2. Fabricate to sizes, shapes, and profiles indicated on Drawings and as necessary to receive adjacent construction. Cut, drill, and tap units to receive hardware, hangers, and similar items:
 3. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 4. Fabricate units from slotted channel framing where indicated.
 5. Provide inserts for units installed after concrete is placed.
- C. Ceiling-Hung Toilet Partition Supports:
1. Framing for Ceiling Hung Toilet Compartments: Provide framing for ceiling hung toilet compartments, coordinated with the partitions and including provisions for partition anchorage as required to sustain imposed loads and to limit deflections to L/360 between hangers, fabricated from the following.

- a. Structural Steel Shapes, Plates and Bars: ASTM A36/A36M.
 - b. Modular Structural Framing System: ASTM A1011/A1011M; modular, structural quality steel preformed U-channel framing system with continuous open slot prepared to receive attachment nuts, bolts, straps, threaded rods, beam clamps, hanger rods support brackets and other accessories. Provide corrosion resistant finish.
 - c. Provide steel rods, 1/2 inch (13 mm) diameter, spaced at maximum 36 inches (900 mm) o.c. Thread rods to receive anchor and stop nuts. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
 - d. Coordinate installation with toilet compartment manufacturer's written instructions and recommendations.
- D. CMU Partition Head Supports:
1. Fabricate supports from 4 inch x 4 inch x 1/4 inch by 36 inch (100 mm by 100 mm by 6 mm by 900 mm) long structural steel angles. Drill supports a maximum of 12 inches (300 mm) o.c. to receive expansion bolts.
- E. Operable Partition Supports:
1. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- F. Shelf Angles:
1. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4 inch (19 mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - a. Provide mitered and welded units at corners.
 - b. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
 - c. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
 - d. Galvanize and prime shelf angles located in exterior walls.
 - e. Prime shelf angles located in exterior walls with zinc rich primer.
 - f. Furnish wedge type concrete inserts, complete with fasteners, to attach shelf angles to cast in place concrete.

2.11 STAIRS

- A. Prefabricated Aluminum OSHA Steps:
1. Stairs shall comply with 29 CFR 1910.25.
 2. Materials:
 - a. Aluminum:
 - 1) Sheet and Plate: 5052-H32 complying with ASTM B209/B209M.
 - 2) Extruded Aluminum: 6005-T5, 6061-T6, or 6063-T52 complying with ASTM B221.
 - 3) Seamless Extruded Tube: 6005-T5, 6061-T6, or 6063-T52 complying with ASTM B241/B241M.
 - 4) Extruded Structural Pipe and Tube: 6005-T5, 6061-T6, or 6063-T52 complying with ASTM B429/B429M.
 - 5) Finish: Mill.
 - b. Fasteners: 18-8 Stainless steel complying with ASTM F593.
 3. Engineering: Prefabricated stairs shall be designed by a professional engineer licensed in the project state and shall comply with all applicable regulations.

2.12 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation from Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

2.13 FINISHES

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
 - 1. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

2.15 STAINLESS STEEL FINISHES

- A. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Bright, Directional Polish: No. 4 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing:
 - 1. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products:
 - a. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming:
 - 1. Prepare surfaces to comply with requirements indicated below:
 - a. Exterior items: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
 - b. Items indicated to receive zinc-rich primer: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
 - c. Items indicated to receive primers specified in Section 09 96 00 - High-Performance Coatings: SSPC SP6/NACE No. 3, "Commercial Blast Cleaning."
 - d. Other items: SSPC SP3, "Power Tool Cleaning."
- E. Shop Priming:
 - 1. Apply shop primer to comply with SSPC PA1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting:
 - a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

3.2 FIELD CONDITIONS

- A. Field Measurements:
 - 1. Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication:
 - a. Established dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - b. Provide allowance for trimming and fitting at site.

3.3 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack, and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding:
 - 1. Comply with the following requirements:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection:
 - 1. Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - a. Cast aluminum: Heavy coat of bituminous paint.
 - b. Extruded aluminum: Two (2) coats of clear lacquer.

3.4 INSTALLING BOLLARDS

- A. Fill metal capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 - 1. Do not fill removable bollards with concrete.
- B. Install plumb.
- C. Backfill as indicated on Drawings.

3.5 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on shop drawings.
- B. Anchor supports for ceiling-hung toilet partitions, CMU partition head supports, operable partitions, overhead coiling doors, and overhead coiling grilles securely to, and rigidly braced from, building structure.
 - 1. Ceiling Hung Toilet Partitions: Anchor supports securely to, and rigidly brace from, overhead building structure.
 - 2. CMU Partition Head Supports: Unless otherwise indicated place partition head supports on alternate faces of CMU partitions every 6 feet o.c. and expansion bolt to underside of structure. Do not bolt to CMU partitions.

3.6 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch (6mm) per story, noncumulative.
- B. Maximum Offset from True Alignment: 1/4 inch (6mm).
- C. Maximum Out of Position: 1/4 inch (6mm).

3.7 ADJUSTING AND CLEANING

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC PA1 for touching up shop painted surfaces:
 - a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
 - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 - Painting and Coating.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 05 51 00 - METAL STAIRS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Preassembled steel stairs.
 - 2. Concrete-filled metal pan stairs.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 05 52 00 - Metal Railings: Railings for use with Metal Stairs.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- C. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- F. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.
- G. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.
- H. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- J. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- K. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- L. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- M. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- N. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- O. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.

- P. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.
- Q. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- R. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- S. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- T. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.
- U. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.
- V. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).
- W. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- X. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- Y. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- Z. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of steel stairs and railings to design stairs and railings.
- B. Structural Performance of Stairs:
 - 1. Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - a. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 - b. Concentrated load: 300 lbf (1.33 kN) applied on an area of 4 square inches (2580 sq. mm).
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - d. Stair framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - e. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. Accessibility Guidelines:
 - 1. Treads, Riser, and Nosings:
 - a. Interior stairs shall have the upper approach and lower tread marked by a stripe providing clear visual contrast. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
 - b. Stripe providing clear visual contrast shall be between 2 and 4 inches (51 and 102 mm) wide placed parallel to, and not more than 1 inch (25 mm) from the nose of the step or upper approach. The stripe shall extend the full width of the step or upper approach and shall be of material that is at least as slip resistant as the other treads of the stair. A painted stripe shall be acceptable. Grooves shall not be used to satisfy this requirement.
 - c. Radius of curvature at the leading edge of the tread shall be no greater than 1/2 inch (13 mm). Nosings that project beyond riser shall have the underside of the leading edge curved or beveled. The maximum angle for a rise to slope under the tread shall be 30 degrees from vertical. Nosings shall extend 1-1/4 inch (32 mm) maximum over the tread below.

- d. Treads shall be 11 inches (279 mm) deep minimum solid galvanized. Risers shall be between 4 and 7 inches (102 and 178 mm) high. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted.

1.5 SUBMITTALS

- A. Product Data:
 1. Technical data for metal pan stairs and the following:
 - a. Prefilled metal pan stair treads.
 - b. Precast concrete treads.
 - c. Epoxy resin filled stair treads.
 - d. Nonslip aggregates and nonslip aggregate finishes.
 - e. Abrasive nosings.
 - f. Paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type and finish of nosing and tread.
- D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Welding Certificates.
- F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Welding qualifications:
 - a. Qualify procedures and personnel according to the following:
 - 1) AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
- B. Installer Qualifications: Fabricator of products, having minimum of 5 years documented experience in the fabrication and installation of metal stairs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. American Stair Corporation, Inc.: www.americanstair.com.
 2. Lapeyre Stair Inc.: www.lapeyrestair.com.
 3. Pacific Stair Corporation: www.pacificstair.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 1. Welding shall comply with AWS D1.1/D1.1M.

2.3 MATERIALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

- C. Steel Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- D. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- E. Uncoated, Cold Rolled Steel Sheet: ASTM A1008/A1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- F. Uncoated, Hot Rolled Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- G. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.
- H. Expanded Metal, Carbon Steel: ASTM F1267, Class 1 (uncoated).
- I. Perforated Metal: Cold rolled steel sheet, ASTM A1008/A1008M, or hot rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B.
- J. Perforated Metal: Galvanized steel sheet, ASTM A653/A653M, G90 (Z275) coating, commercial steel Type B.
- K. Woven Wire Mesh: Intermediate crimp, two-inch (50 mm) woven wire mesh, made from 0.135 inch (3.5 mm) nominal diameter wire complying with ASTM A510/A510M.
- L. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- M. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- N. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (extruded architectural bronze).
- O. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (lead red brass) or No. C84400 (lead semi-red brass).
- P. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent lead nickel bronze).
- Q. Fasteners:
 - 1. Provide zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required:
 - a. Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A with hex nuts, ASTM A563/A563M and, where indicated, flat washers.
 - b. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M and, where indicated, flat washers:
 - 1) Provide mechanically deposited or hot dip, zinc coated anchor bolts.
 - c. Post Installed Anchors:
 - 1) Torque controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency:
 - (a) Material for interior locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - (b) Material for exterior locations and where stainless steel is indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 and nuts, ASTM F594.
- R. Miscellaneous Materials:
 - 1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide Series 10 Tnemec Primer by Tnemec.

2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.
4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Series 90-97 Tneme-Zinc by Tnemec.
6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
7. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 - Cast-In-Place Concrete for normal weight, air entrained, ready mix concrete with a minimum 28-day compressive strength of 3,000 psi (20 MPa) unless otherwise indicated.
8. Non-Slip Aggregate Concrete Finish: Factory packaged abrasive aggregate made from fused, aluminum oxide grits or crushed emery; rustproof and non-glazing; unaffected by freezing, moisture, or cleaning materials.
9. Welded Wire Reinforcement: 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.4 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure:
 1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.5 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing:

1. Hot dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products:
 - a. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - b. Fill vent and drain holes that are exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 Power Tool Cleaning.
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel for shop painting.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance rated stair enclosure.

3.2 INSTALLING METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 - Cast-In-Place Concrete. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- G. Install precast concrete treads with adhesive supplied by manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting:
 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC PA1 for touching up shop painted surfaces:

- a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M .

END OF SECTION 05 51 00

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SECTION 05 52 00 - METAL RAILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Steel pipe and tube railings.
 - 2. Gates.
- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating: Painting.
 - 2. Section 09 96 00 - High-Performance Coatings: High-performance coatings.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- F. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.
- G. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- I. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- J. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- K. ASTM E894 - Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings; 2018 Edition, April 1, 2018.
- L. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- M. ASTM F900 - Standard Specification for Industrial and Commercial Steel Swing Gates; 2017.
- N. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).
- O. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- P. ASTM F2329/2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; 2015.

- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- R. {RSTEMP#1253}
- S. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- T. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.
- U. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Technical data for railings and the following:
 - a. Manufacturer's product lines of mechanically connected railings.
 - b. Railing brackets.
 - c. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples:
 - 1. For each type of exposed finish required:
 - a. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - b. Fittings and brackets.
 - c. Assembled sample of railing system, made from full size components, including top rail, post, handrail, and infill. Sample need not be full height:
 - 1) Show method of connecting and finishing members at intersections.
- D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For testing agency.
- F. Mill Certificates: Signed by manufacturers of stainless steel products certifying that products furnished comply with requirements.
- G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- H. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935 .
- I. Evaluation Reports: For post installed anchors, from ICC-ES.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer licensed in the State in which the Project is located and experienced in the design of railings, including attachment to building construction.
- B. Structural Performance:
 - 1. Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - a. Handrails and Top Rails of Guards:
 - 1) Uniform load of 50 lbf/ft (0.73 kN/m) applied in any direction.
 - 2) Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - 3) Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf/ft (0.73 kN/m) applied horizontally on an area of 1 square foot (0.093 sq. m) .
 - b. Infill load and other loads need not be assumed to act concurrently.

- C. Thermal Movements:
 - 1. Allow for thermal movements from ambient and surface temperature changes:
 - a. Temperature change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements:
 - a. Americans with Disabilities Act of 1990, as amended:
 - 1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
 - 2. Welding qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M Structural Welding Code – Steel.
 - b. {RS#1253} Structural Welding Code - Aluminum.
 - c. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
 - d. AWS D1.6/D1.6M Structural Welding Code - Stainless Steel.
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Steel Pipe and Tube Railings:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Texas Accessibility Standards (TAS).
 - 2. Welding qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M Structural Welding Code – Steel.
 - b. {RS#1253} Structural Welding Code - Aluminum.
 - c. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
 - d. AWS D1.6/D1.6M Structural Welding Code - Stainless Steel.

2.3 MATERIALS

- A. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors:
 - 1. Formed metal of same type of material and finish as supported rails unless otherwise indicated:
 - a. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2 inch (38 mm) clearance from inside face of handrail to finished wall surface.
- C. Steel and Iron:
 - 1. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.

2. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
3. Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Fasteners:
 1. Ungalvanized Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
 2. Hot Dip Galvanized Railings: Type 304 stainless steel or hot dip zinc coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/2329M for zinc coating.
 3. Provide exposed fasteners with finish matching appearance, including color and texture of railings.
 4. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
 5. Fasteners for Interconnecting Railing Components:
 - a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 - b. Provide tamper resistant hex socket flat head machine screws for exposed fasteners unless otherwise indicated.
- E. Miscellaneous Materials:
 1. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 2. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
 3. Galvanizing Repair Paint: High zinc dust content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
 4. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
 5. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
 6. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
 7. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tnemec-Zinc 90-97 by Tnemec Company.
 8. Bituminous paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
 9. Non-Shrink, Non-Metallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 10. Hardware:
 - a. Gate Hardware:
 - 1) Basis of Design Product:
 - 2) 3/4 by 12 inch (19 by 305 mm) bolt hooks, 2 inch (51 mm) hinges, related chains and hardware included in hardware package.
 - b. Gates:
 - 1) Basis of Design Product:
 - (a) Bolt Hook Heavy Duty Gates manufactured by Behlen Country.
 - 2) Replacement bolt hook for installation of 2 foot (610 mm) gates.
 11. Man Gates:

- a. 34 inch (864 mm) clearance, 10 inch (254 mm) galvanized kick plate with 3-1/2 inch (89 mm) bottom clearance to ground.
- b. Framing: Fabricate swing gates in accordance with ASTM F900 using galvanized steel tubular members, 2 inches (51 mm) square, weighing 2.60 lb/ft. Fusion or stainless steel welded connections forming rigid one-piece unit.
- c. Gate Posts:
 - 1) Steel pipe, ASTM F1083, standard weight Schedule 40; minimum yield strength of 25,000 psi (172 MPa). Hot-dipped galvanized with minimum 1.8 oz/ft² of zinc. Width for single gate or one gate leaf of double gates:
 - (a) 6 feet (1,829 mm) or less: 2.875 inches (73 mm) in diameter, weighing 5.79 lb/ft.
 - (b) Over 6 feet (1,829 mm) to 12 feet (3,658 mm): 4.00 inches (102 mm) in diameter, weighing 9.11 lb/ft.
 - (c) Over 12 feet (3,658 mm) to 19 feet (5,791 mm): 6.625 inches (168 mm) in diameter, weighing 18.97 lb/ft.
 - (d) Over 19 feet (5,791 mm) to 23 feet (7,010 mm): 8.625 inches (219 mm) in diameter, weighing 28.55 lb/ft.
- d. Man Gate Hardware Materials:
 - 1) Hot dipped galvanized steel or malleable iron shapes to suit gate size:
 - (a) Hinges: Structurally capable of supporting gate leaf and allowing opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees inward.
 - (b) Latch: Spring slide latch capable of retaining gate in closed position with provision for padlock. Latch shall permit operation from either side of gate.
 - (c) Keeper:
 - (1) Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
 - (2) Provide keeper for each gate leaf over 5 feet (1,524 mm) wide.
 - (d) Drop Rod: Provide at double gates to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.

2.4 STEEL TUBE RAILING SYSTEMS

- A. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads:
 - 1. Rails and Posts: Size and finish as indicated on Drawings.

2.5 FABRICATION, GENERAL

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.

- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections:
 - 1. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings:
 - a. Finish welds to comply with NOMMA Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint as shown in NAAMM AMP 521.
 - 2. Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- I. Non-Welded Connections:
 - 1. Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints:
 - a. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Exposed Ends: Close exposed ends of railing members with prefabricated end fittings.
- L. Returns:
 - 1. Provide wall returns at ends of wall mounted handrails unless otherwise indicated.
 - 2. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors:
 - 1. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work:
 - a. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous metal components.
 - b. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt that provides 1-1/2 (38 mm) clearance from inside face of handrail to finished wall surface.
 - 2. Fillers: Provide fillers made from steel plate, or other suitably crush resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- P. For removable railing posts, fabricate slip fit sockets from steel tube or pipe whose Interior Diameter is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than 1/40 of post height. Provide socket covers designed and fabricated to resist being dislodged.
- Q. Toe Boards:

1. Where indicated, provide toe boards at railings around openings and at edge of open sided floors and platforms.
2. Fabricate to dimensions and details indicated.
3. Fabricate of same material as railings unless noted otherwise.

2.6 FABRICATION OF GATES

- A. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.

2.7 FABRICATION OF STEEL RAILINGS

- A. Connections shall be as indicated on Drawings.
- B. Form Changes in Direction As detailed.
- C. Connect posts to stair framing by direct welding unless otherwise indicated.
- D. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- E. For Non-Galvanized Steel Railings: Provide non-galvanized ferrous metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

2.8 FABRICATION OF STAINLESS STEEL RAILINGS

- A. Connections shall be as indicated on Drawings.
- B. Form Changes in Direction As detailed.

2.9 FINISHES

- A. Steel and Iron Finishes:
 1. Galvanized Railings:
 - a. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 - b. Comply with ASTM A123/A123M for hot dip galvanized railings.
 - c. Comply with ASTM A153/A153M for hot dip galvanized hardware.
 - d. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - e. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - f. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
 2. Painted Railings:
 - a. Preparation for Shop Priming:
 - 1) Prepare uncoated ferrous metal surfaces to comply with SSPC SP6/NACE No. 3 Commercial Blast Cleaning:
 - (a) Exterior Railings: SSPC SP6/NACE No. 3 Commercial Blast Cleaning.
 - (b) Railings to Receive Zinc Rich Primer: SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.
 - (c) Other Railings: SSPC SP3 Power Tool Cleaning.
 - b. Primer Application:
 - 1) Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC PA1 Shop, Field, and Maintenance Painting of Steel for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 2) Do not apply primer to galvanized surfaces.
 - c. Paint:

- 1) Finish: Refer to Section 09 90 00 - Painting and Coating.
- 2) Color and Gloss: As selected by the Architect.
- d. High Performance Coating:
 - 1) Apply epoxy intermediate and polyurethane topcoats to prime coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC PA1 Shop, Field, and Maintenance Painting of Steel for shop painting. Apply at spreading rates recommended by coating manufacturer:
 - 2) Color and Gloss: As selected by the Architect.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacture's written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.
- D. Coordinate with District on railings specific to animal control or livestock access.

3.2 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
- B. Grade elevation review to actual conditions.
- C. Coordinate elevation to specific use with livestock, large and small.

3.3 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for installer. Locate reinforcements and mark locations if not already done.

3.4 INSTALLATION

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack:
 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Control of Corrosion:
 1. Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials:
 - a. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

- D. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding or bolting to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.
- E. Attach handrails to wall with wall brackets. Locate brackets at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.5 RAILING CONNECTIONS

- A. Non-Welded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (152 mm) of post.

3.6 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with non-shrink, non-metallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core drill holes not less than 5 inches (127 mm) deep and 3/4 inch (19 mm) larger than outside diameter of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members:
 - 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- E. Install removable railing sections, where indicated, in slip fit metal sockets cast in concrete.

3.7 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using nonwelded connections.

- C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled in expansion shields and hanger or lag bolts.
 - 2. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 3. For steel framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.8 ADJUSTING AND CLEANING

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC PA1 requirements for touching up shop painted surfaces:
 - a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.9 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 00

SECTION 05 55 16 - METAL STAIR NOSINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded aluminum finishing and edge-protection profiles for stair nosings
 - 2. Steel finishing and edge-protection profiles for stair nosings
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 06 10 00 - Rough Carpentry: Plywood subfloor and underlayment
 - 3. Section 07 92 00 - Joint Sealants.
 - 4. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board and tile backer boards
 - 5. Section 10 26 00 - Wall and Door Protection.

1.3 REFERENCE STANDARDS

- A. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Samples:
- C. Certificates:
 - 1. Certify that products of this section meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. American Safety Tread Co., Inc.: www.americansafetytread.com.
 - 2. Amstep Products: www.amstep.com.
 - 3. Armstrong Products, Inc.: www.armstrongproducts.com.
 - 4. Balco: www.balcousa.com.
 - 5. Nystrom, Inc.: www.nystrom.com.
 - 6. Pemko Manufacturing Co.: www.pemko.com.
 - 7. Safe-T-Metal Co.: www.safetmetal.com.
 - 8. Schluter Systems, L.P.: www.schluter.com.
 - 9. Wooster Products Inc.: www.woosterproducts.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Texas Accessibility Standards (TAS).

2.3 STAIR NOSINGS

- A. Extruded Metal Units:

1. General:
 - a. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
 - b. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
 - c. Apply clear lacquer to concealed surfaces of extruded units set into concrete.
2. MSN-6: Composite Stair Nosing for Metal Pan Stairs
 - a. Basis of Design Product:
 - 1) Model 8511 manufactured by American Safety Tread.
 - b. Description: Extruded 6063-T-6 aluminum profile, 3 inch (76 mm) wide with 1-3/8 inch (35 mm) lip and 3/4 inch (19 mm) integrated extruded anchor.
 - c. Material and Finish: Mill finish aluminum.
 - d. Abrasive:
 - 1) Material: Aluminum oxide and silicon carbide in epoxy binder.
 - 2) Color: As selected by the Architect.
3. MSN-7: Composite Stair Nosing for Metal Pan Stairs
 - a. Basis of Design Product:
 - 1) Model 9311 manufactured by American Safety Tread.
 - b. Description: Extruded 6063-T-6 aluminum profile, 1-7/8 inch (48 mm) wide by 1/4 inch (6 mm) thick with 5/8 inch (16 mm) integrally extruded anchor.
 - c. Material and Finish: Mill finish aluminum.
 - d. Abrasive:
 - 1) Material: Aluminum oxide and silicon carbide in epoxy binder.
 - 2) Color: As selected by the Architect.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Field Measurements:
 - a. Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication:
 - 1) Established dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2) Provide allowance for trimming and fitting at site.

3.2 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack, and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding:
 1. Comply with the following requirements:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.

- d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection:
 - 1. Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - a. Cast aluminum: Heavy coat of bituminous paint.
 - b. Extruded aluminum: Two (2) coats of clear lacquer.

END OF SECTION 05 55 16

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SECTION 05 75 00 - DECORATIVE FORMED METAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Edge-protection and transition profiles for floors.
 - 2. Finishing and edge-protection profiles for walls and countertops.
 - 3. Decorative corner trim.
 - 4. Mirror trim.
- B. Related Sections:
 - 1. Section 09 21 16 - Gypsum Board Assemblies.
 - 2. Section 09 30 00 - Tiling.
 - 3. Section 09 65 00 - Resilient Flooring.
 - 4. Section 09 68 00 - Carpeting.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings; 2020.
- H. ASTM B247M - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings (Metric); 2020.
- I. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Warranty.
- C. Verification Samples: For each finish product specified, minimum size 6 inches (305 mm) square, representing actual product in color and texture.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Package for protection against transportation damage.
 - 2. Provide markings to identify components consistently with drawings.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - 1. Store in well-ventilated space out of direct sunlight.
 - 2. Protect from moisture and condensation.
 - 3. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. C.R. Laurence Co., Inc.: www.crlaurence.com.
 - 2. Fry Reglet Corporation: www.fryreglet.com.
 - 3. Genesis APS International: www.genesis-gs.com.
 - 4. Schluter Systems: www.schluter.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. Flooring Transition (MT-1):
 - 1. Basis of Design Product: RENO-U manufactured by Schluter.
 - 2. Description: profile with sloped exposed surface, 5/32 inch (4 mm) tall leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3. Material and Finish: ATGB - Brushed Nickel Anodized Aluminum.
 - 4. Size: General Contractor to verify per tile thickness.
 - 5. Locations: Typical floor reducer.

2.3 FINISHING AND EDGE-PROTECTION PROFILES

- A. Decorative Trim, (DT-1):
 - 1. Basis of Design Product: JOLLY manufactured by Schluter.
 - 2. Description: L-shaped profile with 1/8 inch (3.2 mm) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 3. Anchoring Leg: Provide with straight or special radius anchoring leg as required.
 - 4. Material and Finish: ATGB - Brushed Nickel Anodized Aluminum.
 - 5. Size: General Contractor to verify per tile thickness.
 - 6. Locations: Typical at all wall tile outside corners and exposed

2.4 DECORATIVE CORNER TRIM

- A. Corner Trim, (CT-1):
 - 1. Basis of Design Product: ECK, 2VA as manufactured by Schluter.
 - 2. Size: K15VA/250.

3. Material and Finish: Stainless Steel Body, Brushed Finish.

2.5 DECORATIVE METAL BASE

- A. Millwork Reveal Base, (MB-1):
 1. Basis of Design Product: Fry Reglet® MWRLXX
 2. Description: 4 inch (102 mm) 4 inch reveal for use with millwork panels.
 - a. Reveal Depth: 1/2 inch (13 mm).
 - b. Reveal Height: 4 inch (102 mm).
 3. Material: Aluminum.
 - a. Finish: Clear Anodized.
 4. Location: To be determined per mill work detail and bistro menu board at all edges.

2.6 MIRROR TRIM

- A. General Requirements:
 1. Corners:
 - a. Frames that are continuous around corners shall be mitered at four-sided frames or 90 degrees when not otherwise indicated.
 - b. Frames that are not continuous around corners shall be cut as indicated on Drawings or as selected by the Architect.
 2. Depth: As needed to accommodate mirror and required shims, gaskets, and other accessories.
 3. Length: As indicated on Drawings.
- B. Channel Frame:
 1. Description: One piece, channel frame.
 2. Material: Stainless steel, type 430.
 3. Finish: Satin.
 4. Leg Height: As indicated on Drawings.
- C. J-Shape Mirror Trim:
 1. Basis of Design Product:
 2. Description: J-Trim with chamfered edge for use as mirror frame.
 3. Visible Leg Height: As indicated on Drawings.
 4. Material: Aluminum complying with ASTM B221 (ASTM B221M), 6005-T6 alloy and temper.
 5. Finish: Satin Anodized.
- D. Roll-Formed Frame:
 1. Description: One piece, roll-formed angle frame.
 2. Material: Stainless Steel, type 430.
 3. Visible Leg Height: As indicated on Drawings.
 4. Finish: Satin.
 5. Corners: Weld, grind, and polish.
- E. U-Shape Mirror Trim:
 1. Basis of Design:
 2. Description: U-Trim with chamfered edge for use as mirror frame.
 3. Visible Leg Height: As indicated on Drawings.
 4. Material: Aluminum complying with ASTM B221 (ASTM B221M), 6005-T6 alloy and temper.
 5. Finish: Anodized, clear.

2.7 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209/B209M.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221/ASTM B221M, Alloy 6063-T5/T52.
 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M, Alloy 6063-T6.
 4. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
 5. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
 6. Die and Hand Forgings: ASTM B247/ASTM B247M, Alloy 6061-T6.
 7. Castings: ASTM B26/B26M, Alloy A356.0-T6.
- B. Factory Finish:
1. Color Anodic Coating: AA-M12C22A44, AAMA 611, Architectural Class I.

PART 3 EXECUTION

3.1 APPLICATION

- A. Consult manufacturer's current technical literature for proper design and installation instructions.

END OF SECTION 05 75 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rough carpentry, light hardware, and miscellaneous items of work not included in another Section.
 - 2. Structural wood supports, grounds, backing, and blocking required for millwork and casework items that are an integral part of wall, floor, and/or ceiling construction.
 - 3. Plywood sheathing.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 07 21 00 - Thermal Insulation.
 - 4. Section 07 92 00 - Joint Sealants.
 - 5. Section 09 21 16 - Gypsum Board Assemblies.
 - 6. Section 09 24 00 - Cement Plastering.
 - 7. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

- A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength; 2021.
- B. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.

1.4 REFERENCES

- A. The following references, codes, and standards are hereby made a part of this Section and carpentry work shall conform to applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained in the Drawings or these Specifications shall be construed as permitting work that is contrary to code requirements:
 - 1. Standard Grading and Dressing Rule #16, of the West Coast Lumber Inspection Bureau.
 - 2. Grading Rules for Western Lumber of the Western Wood Products Association.
 - 3. Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
 - 4. American Wood Preservers Association (AWPA) Standard C 2-77 Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes.
 - 5. American Wood Preservers Bureau (AWPB) Quality Control Standards.

1.5 QUALITY ASSURANCE

- A. Lumber and plywood shall be grade or quality marked by WWP, WCLIB, APA, AWPB, or by other grading and inspection agencies acceptable to the Architect. Grade marks shall include the designation "S-DRY"(or "MC-15" as applies) where applicable. Grade and quality marks shall not be apparent on surfaces exposed in the finished work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store kiln dried materials in enclosed areas, protected from moisture and separated from contact with concrete or soil.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
- B. The following references, codes, and standards are hereby made a part of this Section and carpentry work shall conform to applicable requirements therein except as otherwise specified herein or shown on the Drawings. Nothing contained in the Drawings or these Specifications shall be construed as permitting work that is contrary to code requirements:
 - 1. Standard Grading and Dressing Rule #16, of the West Coast Lumber Inspection Bureau.
 - 2. Grading Rules for Western Lumber of the Western Wood Products Association.
 - 3. Standard Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service.
 - 4. American Wood Preservers Association (AWPA) Standard C 2-77 Lumber, Timbers, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes.
 - 5. American Wood Preservers Bureau (AWPB) Quality Control Standards.

2.3 MATERIALS

- A. Temporary Construction: Clean lumber at Contractor's option, rough or smooth, as usage requires.
- B. Lumber Not Otherwise Specified or Noted:
 - 1. Douglas fir or larch, graded and grademarked, according to Reference Standard 1.02 A or B, #1 grade:
 - a. Boards: Construction grade.
- C. Plywood for Walls and Roofs; as Indicated on Drawings:
 - 1. Unless glue type is otherwise specified, exterior plywood, interior plywood exposed to continuing moisture, and pressure treated plywood shall be fabricated with exterior glue. Plywood with interior glue shall be fully protected from soaking or continuing moisture at all times.
- D. Rough Hardware:
 - 1. Nails, spikes, bolts, screws, tacks, and framing connectors of standard manufacture as required. Hot dip galvanize items exposed to moisture or to exterior and those items that are in contact with wood pressure treated with waterborne salts:
 - a. Bolts and Nuts: ASTM A307, Grade A.
 - b. Lag Bolts: Fed. Spec. FF-B-561. Pre-drill per CBC.
 - c. Nails: Fed. Spec. FF-N-101, common unless otherwise noted or specified.
 - d. Joist Hangers and Framing Connectors: Simpson or approved equal, unless otherwise noted.
 - e. Power Driven Fasteners: Hilti, Ramset, or approved equal, each use and fastener type subject to prior approval by the Architect.
- E. Pressure Treatment (Decay and Termite Prevention):
 - 1. Pressure treat for decay and termite prevention, Douglas fir or larch wood materials that are embedded in or set against concrete.
 - 2. Treat in accordance with applicable standard

3. Provide with quality mark per applicable standard.
 4. Treat with any of the following processes at the Contractor's option. Creosote type preservatives are not permitted:
 - a. Penta in an LPG carrier (Cellon) or Penta in Hydrocarbon Solvent-Type D (Dow Process) AWPB LP-4 quality marked.
 - b. Ammoniacal copper arsenate (ACA) or chromated copper arsenate (CCA) in a water carrier (AWPB LP-2 quality marked).
 - c. Disodium Octaborate Tetrahydrate (DOT) such as Advance Guard/Hi-bor by Osmose, Inc.
 - d. Members treated with waterborne salts shall be dried to a moisture content not exceeding 19 percent after treatment.
 5. Where possible, precut material before treatment.
 6. Holes and cutoffs and handling and storage shall be in accordance with AWPB M-4.
 7. Ensure that ferrous metal fastenings and items in contact with wood treated with waterborne salts are hot dip galvanized (1.25 oz. coating) where required by ICC reports.
- F. Framing Connectors: Simpson Strong Tie Corp., or equal.

2.4 MOISTURE CONTENT

- A. 19 percent maximum for two times thickness and less; 19 percent maximum for thickness greater than two times and less than four times; and 22 percent maximum for thickness greater than four times.

2.5 SIZES

- A. Surfaced to "DRY" sizes. Sizes noted are nominal unless indicated as net.

2.6 SURFACING

- A. All wood materials exposed in the finished work shall have re-sawn surfaces of clean natural color unless noted or specified otherwise. Concealed framing lumber shall be S4S.

PART 3 EXECUTION

3.1 ERECTION AND INSTALLATION

- A. Framing:
1. Properly lay out framing with pieces closely fitted, accurately plumbed, leveled and aligned, and rigidly secured in place.
- B. Except as specifically shown on structural drawings, cutting of all wood, etc. is limited to those cuts permitted by applicable Building Code.
- C. Bridging and Blocking:
1. Provide two times blocking at intersections of finished surfaces for adequate bearing and at points where required to support fixtures, cabinets, hardware, and other equipment mounted on walls.
- D. Plywood (General): Unless more stringent requirements are indicated on the Drawings or required by code, application of plywood shall be in accordance with recommendations of the American Plywood Association.
- E. Connections and Fastenings:
1. For bolted connections, provide washers under heads and nuts bearing on wood, and draw nuts tight. Retighten before closing in framing.
 2. Exercise care in nailing through exposed sheathing and siding and ensure that fasteners penetrate into framing members

END OF SECTION 06 10 00

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SECTION 06 16 00 - SHEATHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Wall sheathing.
 - 2. Underlayment.
 - 3. Sheathing joint and penetration treatment.
 - 4. Accessories necessary for a complete installation.
- B. Related Sections:

1.3 REFERENCE STANDARDS

- A. ASME B18.6.1 - Wood Screws (Inch Series); 1981 Edition, 1981.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- D. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board; 2020.
- E. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.
- G. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- H. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 2012 (Reapproved 2020).
- I. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- J. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- K. ASTM D5516 - Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures; 2018.
- L. ASTM D6305 - Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing; 2021.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- N. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- O. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.
- P. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.
- Q. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
- R. PS 1 - Structural Plywood; 2023.

1.4 SUBMITTALS

A. Product Data:

1. Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details:
 - a. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - b. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - c. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
 - d. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

A. Fire Test Response Characteristics:

1. For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Fire Resistance Ratings: Indicated by design designations from UL Fire Resistance Directory or GA-600 Fire Resistance Design Manual.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- ### **A.**
- Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- ### **A.**
- Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Preservative Treated Plywood:
 - a. Georgia Pacific: www.gp.com.
 2. Wall Sheathing:
 - a. CertainTeed Corporation: www.certainteed.com.
 - b. Georgia Pacific: www.gp.com.
 - c. National Gypsum Company: www.nationalgypsum.com.
 - d. United States Gypsum Co.: www.usg.com.
- ### **B.**
- Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

- C. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.2 MATERIALS

- A. Plywood: DOC PS 1 .
- B. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground:
 - 1. Preservative chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE RETARDANT TREATED PLYWOOD

- A. Where fire retardant treated materials are indicated, use materials complying with requirements acceptable to authorities having jurisdiction and with fire test response characteristics specified determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire Retardant Treated Plywood by Pressure Process:
 - 1. Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test:
 - a. Use treatment that does not promote corrosion of metal fasteners.
 - b. Exterior type: Treated materials shall comply with requirements specified above for fire retardant treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - c. Design value adjustment factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high temperature fire retardant treatment is indicated, span ratings for temperatures up to 170 degrees F (76 degrees C) shall be not less than span ratings specified.
- C. Kiln dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire retardant treated plywood with appropriate classification marking of qualified testing agency.
- E. Application:
 - 1. Treat plywood indicated on Drawings and the following:
 - a. Roof and wall sheathing within 48 inches (1,220 mm) of fire walls.
 - b. Subflooring and underlayment for raised platforms.

2.5 WALL SHEATHING

- A. Glass Mat Gypsum Wall Sheathing - ASTM C1177/C1177M:

1. Basis of Design Product:
 - a. GlasRoc manufactured by CertainTeed Corporation.
 - b. Dens-Glass manufactured by Georgia Pacific.
 - c. Gold Bond eXP manufactured by National Gypsum Company: .
 - d. Securock manufactured by United States Gypsum Co.
2. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
3. Size: 4 by 8 feet (1,220 by 2,440 mm) for vertical installation.

2.6 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor Underlayment: DOC PS 1, Exterior, Structural I, C-C Plugged Single Floor Panels:
 1. Span Rating: Not less than 20 inches (508 mm) o.c.
 2. Nominal Thickness: Not less than 1 inch (25 mm).
 3. Edge Detail: Tongue and groove.
 4. Surface Finish: Fully sanded face.
- B. Underlayment: Provide underlayment in nominal thickness not less than 1/4 inch (6 mm) over smooth subfloors and not less than 3/8 inch (10 mm) over board or uneven subfloors.
- C. Sound Deadening Board: Class C Fire Rated, Molded, Recycled Post-Consumer Paper, Cellulose Fiber Structural Panel:
 1. Density: 26 to 28 pcf (416 to 448 kg/cu. m) tested in accordance with ASTM C209.
 2. Tensile strength when tested in accordance with ASTM C209:
 - a. Parallel: 450 to 700 psi (3100 to 4830 kPa).
 - b. Transverse: 750 to 1000 psi (5.1 to 6.9 kPa).
 3. Hardness (Janka Ball): 230 pounds (104 kg) tested in accordance with ASTM D1037.
 4. Water absorption by volume, when tested in accordance with ASTM C209:
 - a. Two-hour immersion: Maximum seven percent (7%).
 5. Expansion: 50 percent to 90 percent relative humidity, 0.25 percent in accordance with ASTM C209.
 6. Noise reduction coefficient (NCR): 0.20.
 7. Flame spread: Maximum 75 tested in accordance with ASTM E84 Class C.
 8. Thickness: 3/4 inch (19 mm).

2.7 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667/F1667M.
- C. Power Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing:
 1. Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B117:
 - a. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.

2.8 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass Mat Gypsum Sheathing:
 1. Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass fiber sheathing tape and for covering exposed fasteners:

- a. Sheathing tape: Self-adhering glass fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with history of successful in-service use.

2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than 3 support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-216 and with manufacturer's written instructions. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8 inch (10 mm) gap where non-load bearing construction abuts structural elements. Install boards with a 1/4 inch (6 mm) gap where they abut masonry or similar materials that retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation:
 1. Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud:
 - a. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (10 mm) from edges and ends of boards.
- D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

END OF SECTION 06 16 00

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SECTION 06 20 00 - FINISH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Providing all finish carpentry items including, but not limited to:
 - a. Finish carpentry.
 - b. Millwork and cabinetry.
 - c. Plastic laminate.
 - d. Casework hardware.
 - e. Miscellaneous millwork.
 - 2. Installation of:
 - a. Finish hardware.
 - b. Plastic laminate faced wood doors.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 13 34 23.14 - Fabricated Classroom Buildings.

1.3 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- B. BHMA A156.9 - Cabinet Hardware; 2020.
- C. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. KCMA A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets; 2017.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's preprinted product information for all hardware proposed on the Project.
 - 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
 - 1. Indicate size, material, and finish.
 - 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim, and other pertinent data for each unit.
- C. Certification: Provide manufacturer's certification that casework has been fabricated and installed according to WI "Custom" Grade guidelines or better.
- D. Samples: Two each, 6 inches by 6 inches by 3/4 inch (152 mm by 152 mm by 19 mm) sample of specified particleboard core with grade stamp for use as verification of installed product.
- E. Closeout:
 - 1. Record drawings: Indicate revisions to original Drawings and shop drawings.
 - 2. Manufacturer contact names, addresses, and phone numbers.

3. Finish material schedule: Names and color numbers of laminates and stains.
4. Keys: Provide additional master key for each room and additional locksets totaling one percent (1%) of total Project for attic stock.

1.5 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, perform work in accordance with WI "Architectural Woodwork Standards," Custom Grade, except where specification exceeds those standards the more stringent shall govern.
- B. Fabricate millwork and cabinetry in accordance with KCMA A161.1, NEMA LD 3, and general static load testing performed and certified by an independent testing agency covering the following areas of product performance, with these minimum results:
 1. Base cabinet construction/racking test: 800 pounds (363 kg).
 2. Cabinet front joint loading test: 425 pounds (193 kg).
 3. Wall cabinet static load test: 2,000 pounds (907 kg).
 4. Drawer front joint loading test: 600 pounds (272 kg).
 5. Drawer construction/static load test: 750 pounds (340 kg).
 6. Cabinet adjustable shelf support device/static load test: 300 pounds (136 kg).
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.6 QUALITY ASSURANCE

- A. Manufacturers and fabricators must be Woodwork Institute listed Accredited Millwork Companies, current roster.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.
- C. Installer Qualifications: Licensee of WI's Certified Compliance Program.
- D. Quality Standard:
 1. Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements:
 - a. Before delivery to jobsite, millwork supplier:
 - 1) Licensees of WI shall issue a certified compliance certificate indicating millwork products being furnished for this Project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
 - 2) Non-licensees of WI shall provide evidence that they have arranged for inspection by WI inspector after completion of fabrication and installation. If conditions are found to be compliant, inspector will issue Compliance Certificate indicating millwork products being furnished for this Project and certifying that these products and their installation will fully meet requirements of grade or grades specified.
 - b. Each elevation of casework and each countertop shall bear certified compliance label.
 - c. Cabinet Design Series (CDS): CDS numbers on Drawings indicate typical designs.
- E. Pre-Installation Conference:
 1. Refer to Section 01 31 00 - Project Management and Coordination.

1.7 WARRANTY

- A. Warranty the work specified herein for 5 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:

1. Rough or difficult operation, or loose or missing parts.
2. Delamination of surfaces.
3. Noticeable deterioration of finish.
4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver completed laminate clad casework, countertops, and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Plastic Laminate:
 - a. Abet Laminati, Inc: abetlaminati.com.
 - b. Formica Corporation: www.formica.com.
 - c. Panolam Industries International Inc: panolam.com/hpl-high-pressure-laminate.
 - d. Wilsonart, LLC: www.wilsonart.com.
 2. Millwork Fabricators:
 - a. Calmar Manufacturing Co., Inc., a subsidiary of Imperial Woodworking Company: www.calmarmanufacturing.com.
 - b. Case Systems, Inc.: www.casesystems.com.
 - c. Global Casework Manufacturing, Inc.: www.globalcasework.com.
 - d. Jericho Woodworks: www.jericho-woodworks.com.
 - e. MGC, Inc.: www.mgcinc.net.
 - f. Stevens Industries, Inc.: www.stevensind.com.
 - g. Terrill Manufacturing Co.: www.terrillmfg.com.
 - h. TMI Systems Design Corp.: www.tmisystems.com.
 - i. Woodwork Institute listed Accredited Millwork Companies, current roster, this shall not preclude the Contractor from using other manufacturers, provided they produce equivalent products of the type specified for the scope and size of the Project.
 3. Hardware:
 - a. Doug Mockett & Company, Inc.: www.mockett.com.
 - b. Grass America: www.grassusa.com.
 - c. Hafele North America Co.: www.hafele.com.
 - d. Julius Blum & Co., Inc.: www.juliusblum.com.
 - e. Knappe & Vogt: www.knappeandvogt.com.
 4. Upholstery Fabric:
 - a. Arc|Com: www.arc-com.com.
 - b. Designtex: www.designtex.com.
 - c. Duvaltex: www.duvaltex.com.
 - d. Guilford of Maine, a Duvaltex brand: www.guilfordofmaine.com.
 - e. Knoll, Inc.: www.knoll.com/shop-textiles.
 - f. Maharam: www.maharam.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

- A. Regulatory Requirements:
1. International Building Code ICC (IBC).
 2. Texas Accessibility Standards (TAS).

2.3 MILLWORK MATERIALS

- A. Plastic Laminate:
1. High-pressure decorative laminate complying with NEMA LD 3, and the following requirements:
 - a. Exterior Color Selection Available:
 - 1) The Architect shall select from minimum of 250 selections available, including wood grain patterns and solid colors.
 - (a) Provide five different colors available per project.
 - 2) PL-1: Plastic Laminate .
 - (a) Manufacturer: Panolam industries International Inc.
 - (b) Color: Cinnamon Noce FW-258-SD.
 - (c) Finish: As selected by the Architect from manufacturer's full line.
 - (d) Location: Refer to interior elevations.
 - (e) Include Stainless Steel Corner Gaurds (CT-1) at all outside corners.
 - (1) Provide matching caulk at butt joints and inside corners.
 - 3) PL-3A: Plastic Laminate .
 - (a) Manufacturer: Panolam indsutries International Inc.
 - (b) Color: Custom Print with Graphics provided by Bluering.
 - (c) Finish: As selected by the Architect from manufacturer's full line.
 - (d) Location: Refer to interior elevations.
 - (e) Include Stainless Steel Corner Gaurds (CT-1) at all outside corners.
 - (1) Provide matching caulk at butt joints and inside corners.
 - 4) PL-3B: Plastic Laminate .
 - (a) Manufacturer: Panolam Industries International Inc..
 - (b) Color: Custom Print with Graphics provided by Bluering.
 - (c) Finish: As selected by the Architect from manufacturer's full line.
 - (d) Location: Refer to Interior elevations.
 - (e) Include Stainless Steel Corner Gaurds (CT-1) at all outside corners.
 - (1) Provide matching caulk at butt joints and inside corners.
 - 5) PL-4: Plastic Laminate .
 - (a) Manufacturer: Pionite.
 - (b) Color: Sable AG021.
 - (c) Finish: As selected by the Architect from manufacturer's full line.
 - (d) Location: Doors & Millwork Vertical Faces.
 - 6) PL-5: Plastic Laminate .
 - (a) Manufacturer: Wilsonart, LLC.
 - (b) Color: Metallic Plam.
 - (c) Finish: Satin Brushed Palladium.
 - (d) Location: Refer to Interior Elevations.
 - (e) System: PSI System 310 with Black trims.
 - 7) PL-6: Plastic Laminate .
 - (a) Manufacturer: Wilsonart, LLC.
 - (b) Color: Regimental Red, D12K-18.
 - (c) Finish: As selected by the Architect from manufacturer's full line.
 - (d) Location: Flex Area.
 - (e) System: PSI System 310 with Black Trims.

- 8) PL-7: Plastic Laminate .
 - (a) Manufacturer: Formica Corporation.
 - (b) Type: Magnetic Markerboard
 - (c) Color: M2253-58, Chalkboard Black.
 - (d) Location: Refer to interior elevations.
 - 9) PLC-1: Plastic Laminate .
 - (a) Manufacturer: Pionite.
 - (b) Color: White Fiesta.
 - (c) Finish: As selected by the Architect from manufacturer's full line.
 - (d) Location: Millwork Horizontal Faces.
 - 10) If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
2. Laminate Grades:
 - a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch (0.7 mm) thick nominal)
 - b. Horizontal surfaces other than top: GP28 (0.028 inch (0.7 mm) thick nominal)
 - c. Cabinet Liner: CL20 (0.020 inch (0.5 mm) nominal), white.
 - d. Work surfaces and countertops: GP50 (0.050 inch (1.3 mm) thick nominal) with BK20 (0.20 inch (5.1 mm) thick) backer sheet.
 - e. Backsplash: PH42 (0.042 inch (1.1 mm) nominal) with nominally balanced backer sheet.
 3. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
 4. Pressure Fused Laminate:
 - a. NEMA LD 3 VGL, and NEMA LD 3 CLS, melamine resin impregnated, 120-gram PSM minimum, thermofused to core under pressure.
 - b. Color:
 - 1) Closed interiors, underside of wall cabinets: White.
 - 2) Exposed and semi-exposed open cabinets: Match exterior.
 - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.
- B. Core Material:
1. Medium-density fiberboard: ANSI A208.2, Grade MD.
 2. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
 3. Water resistant treated plywood shall have 24 hour thickness swell factor of 5 percent or less and 24 hour water absorption factor of 10 percent or less; P.S. 51, Type II or better.
 4. Cabinet components shall be of the following minimum core thicknesses:
 - a. Cabinet Backs, Drawer Body, and Drawer Bottoms: 1/2 inch (13 mm) plywood
 - b. Door and Drawer Face, Base, Wall, and Tall Cabinet Tops and Bottoms, Cabinet Sides, Drawer Spreaders, Cabinet Back Rear Hangstrips, Structural Dividers, and Exposed Cabinet Backs: 3/4 inch (19 mm) plywood
 - c. Work Surfaces and Countertops: Minimum 1 inch (25 mm) plywood. Use water resistant treated plywood core at counters with sinks.
 - d. Shelves: 3/4 inch (19 mm) plywood core for 30 inches (762 mm) long or less, 1 inch (25 mm) thick plywood core for more than 30 inches (762 mm) long; 14 inch (356 mm) deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches (914 mm) long.
 - e. Cabinet Toe-Base: Full pressure-treated 2 x 4 frame base. Particleboard, waferboard or legs are not acceptable. Treated wood must be used in all wet areas.

- C. Toe Spaces:
 - 1. Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- D. End Panels and Filler Strips:
 - 1. Match adjacent case-piece.
- E. Edging:
 - 1. Provide the following in accordance with "Edging Locations:"
 - a. Flat-Edge PVC: 0.020 inch (0.5 mm). Solid, high-impact, purified, color-through, acid resistant, machine-applied with hot melt adhesives.
 - b. 1/8 inch (3 mm) PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch (3 mm) radius.
 - 2. Edging Locations:
 - a. Cabinet body edge, including door/drawer front spacer rail:
 - 1) 1/8 inch (3 mm). Flat edge PVC, color as selected by the Architect.
 - b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body:
 - 1) 1/8 inch (3 mm), Flat edge PVC to match cabinet interior surface color.
 - c. Door/drawer-front edging:
 - 1) 1/8 inch (3 mm) PVC, color matched to standard laminates.

2.4 CABINET HARDWARE

- A. All hardware shall meet BHMA A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner:
- B. Hinges:
 - 1. Heavy duty, five-knuckle 2-3/4 inch (70 mm) institutional type hinge complying with BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch (2.4 mm) thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch (16 mm) FHMS to assure positive door attachment.
 - 2. One pair per door to 48 inches (1,219 mm) height. One and one-half pair over 48 inches (1,219 mm) in height. Hinge shall accommodate 13/16 inch (21 mm) thick laminated door and allow 270-degree swing.
 - 3. Finish: US26D.
- C. Pulls:
 - 1. 4 Inch Wire:
 - a. Wire design, 4 inches (102 mm) long.
 - b. Finish: Satin chrome, US26D finish.
- D. Sliding Door Hardware:
 - 1. Frameless 1/4 inch (6 mm) glass sliding doors; double track rolling door assembly.
 - 2. Framed 13/16 inch (21 mm) thick stile and rail sliding doors; top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
 - 1. Standard drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound (45 kg) dynamic load rating at full extension.
 - 2. File drawers: Full extension, three-part progressive opening slide, precision steel ball bearing, minimum 100 pound (45 kg) dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.

3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
 4. Paper storage drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound (68 kg) dynamic load rating at full extension.
- F. Catches:
1. Provide opening resistance in compliance with applicable accessibility regulations:
 - a. Provide top-mounted magnetic catch for base and wall cabinet door.
 - b. Provide two at each tall cabinet door. Catch housing shall be molded in White.
- G. Adjustable Shelf Supports:
1. Dual-pin design with anti-tip-up shelf restraints for both 3/4 inch (19 mm) and 1 inch (25 mm) shelves.
 2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
 3. Load rating shall be minimum 300 pounds each support without failure.
 4. Basis of Design: Products manufactured by Knappe and Vogt.
 - a. Standard: Model 255 Steel.
 - b. Supports: Model 256.
- H. Wardrobe Rod: 1-1/16 inch (27 mm) diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - satin aluminum.
- J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike but must differ throughout the building with a minimum of six (6) different combinations. Provide two keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting the Owner to change lock arrangements without tools.
1. Keys to be delivered to Chief Operating Officer as part of closeout, do not leave any keys in cabinets.

2.5 SPECIALTY ITEMS

- A. Grommets:
1. Basis of Design Product:
 - a. Model No. EDP3 manufactured by Doug Mockett & Company, Inc.
 2. Size: 2-1/2 inch (64 mm) diameter with Flip-Top tab in cap.
 3. Colors: As selected by the Architect from manufacturer's available colors.
 4. Number/location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
- B. Keyboard Drawers (at all knee spaces):
1. Basis of Design Product No. SD-1 as manufactured by Knappe & Vogt.
- C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 pound (45 kg) self-closing slides. Twelve compartment drawer body, and slides, black. Provide where indicated on plans.

2.6 SOLID STOCK

- A. Moisture Content: Percent of moisture in relation to over-dry weight shall be between eight percent (8%) and 13 percent at time of installation.

2.7 MISCELLANEOUS

- A. Utility Shelving: WI "Economy" grade.
- B. Clothes Rod: 1-1/2 inch (38 mm) diameter smooth wooden dowel by length required, with end supports and fasteners of type recommended to suit application.

- C. Telephone/MDF/IDF Board: Provide minimum 4 feet by 8 feet by 3/4 inch (1.2 m by 2.4 m by 19 mm) thick plywood for telephone/data punch down blocks and video equipment in accordance with Section 06 10 00 - Rough Carpentry. Paint in accordance with Section 09 90 00 - Painting and Coating.
- D. Pegboard:
 - 1. Material: Tempered Hardboard.
 - 2. Thickness: 1/4 inch (6 mm).
 - 3. Size: As indicated on Drawings.
 - 4. Accessories: Provide the following:

2.8 MILLWORK FABRICATION

- A. Use the WI Custom Grade woodwork classification unless noted elsewhere complying with referenced quality standard.
- B. Fabricate casework and related products to dimensions, profiles, and details shown on Drawings. Fabricate casework square, plumb, and true.
- C. Detailed Requirements for Cabinet Construction:
 - 1. Toe-Base:
 - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor.
 - b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch (6 mm) from face of finished end for flush installation of finished base material.
 - c. No cabinet sides-to-floor will be allowed.
 - 2. Cabinet Top and Bottom:
 - a. Solid sub-top shall be furnished for all base and tall cabinets.
 - b. At cabinets over 36 inch (914 mm), bottoms and tops shall be mechanically joined by a fixed divider.
 - c. Assembly devices shall be concealed on bottom side of wall cabinets.
 - 3. Cabinet Sides:
 - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
 - b. Drill holes for adjustable shelves 1-1/4 inches (32 mm) on center.
 - 4. Cabinet Backs:
 - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
 - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two at base, two at wall, and three at tall cabinets as instructed by casework manufacturer.
 - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on Drawings.
 - 5. Exposed end corner and face frame attachment:
 - a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
 - 6. Door and Drawer Fronts:
 - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
 - b. Where indicated, provide stile and rail doors with full 1/4 inch (6 mm) plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.

- c. Where indicated, frameless sliding glass doors shall be 1/4 inch (6 mm) thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- D. Drawers:
 - 1. Drawer fronts: Apply to separate drawer body component sub-front.
 - 2. Drawer sides: Doweled to receive front and back, glued under pressure, machine squared.
 - 3. Drawer bottom: Set into front and sides, 1/4 inch (6 mm) deep groove with minimum 3/8 inch (19 mm) standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch (13 mm) by 4 inches (102 mm) front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches (610 mm), two at 36 inches (914 mm), and over.
 - 4. Paper Storage Drawers: Fitted with full width hood at back.
 - 5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.
- E. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- F. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- G. Typical Desk or Counter Height at Knee Space Locations: 30 inches (762 mm) A.F.F.

PART 3 EXECUTION

3.1 JOB CONDITIONS

- A. Environmental Requirements:
 - 1. Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week:
 - a. Manufacturer/supplier shall advise the Contractor of temperature and humidity requirements for architectural casework installation areas.
 - b. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

3.2 COORDINATION

- A. Coordinate the work of this Section with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22 or as indicated on Drawings.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

3.3 MILLWORK INSTALLATION

- A. Positioning: Place approximately level, plumb, and at right angles to adjacent work.
- B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
- C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
- D. Fasten tops to frames with concealed clips, screws, and glue.
- E. Install simulated wood trim in locations shown on Drawings and in accordance with manufacturer's instructions.

3.4 EXISTING DOOR LAMINATE RESURFACING

- A. Resurfacing procedures shall be in accordance with the recommendations and instructions of the laminate and adhesive manufacturers.

- B. Acclimate laminate to the same environment as existing material at least 48 hours. Perform work in well-ventilated area, out of the way of construction dust and traffic to maintain clean adhesion.
- C. Clean the substrate with detergent or non-flammable solvent as instructed by laminate manufacturer to remove wax, grease, and polish deposits.
- D. Using a belt sander or sander instructed by manufacturer, sand entire surface to remove original finish. Remove sanding dust thoroughly.
- E. Coat the sanded surface and back of laminate with a uniform coating of contact adhesive. Allow to dry thoroughly prior to assembling. Assembling wet adhesive lines will trap solvent and may result in poor bonding. Follow the adhesive manufacturer's instructions.
- F. Index the laminate with the substrate. Make initial contact by smoothing with palms. Apply pressure using a "J" roller or rotary press. Allow to set as instructed by adhesive manufacturer to achieve full adhesion to maintain warranty. Trim with recommended tools.
- G. Apply laminate to door faces and exposed vertical edges. Apply edges before face. Paint top and bottom edges to color match facing.
- H. Coordinate hardware and vision lite cutouts with work of other Sections.

3.5 FINISH HARDWARE INSTALLATION

- A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
- B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at their expense.
- C. Provide clean, properly sized, and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.
- D. Fit all surface-applied hardware accurately.
- E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.
- G. Millwork the Contractor shall be responsible for hardware on millwork.

3.6 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION

- A. Protect all doors during handling.
- B. Install doors in accordance with manufacturer's instructions.
- C. Install and adjust doors for smooth, quiet operation.
- D. Refer to Section 08 71 00 - Door Hardware where applicable.

END OF SECTION 06 20 00

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Extruded polystyrene foam plastic board.
 - 2. Polyisocyanurate foam plastic board.
 - 3. Glass mineral fiber blanket.
 - 4. Rock mineral wool blanket.
 - 5. Rock mineral wool board.
 - 6. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 05 40 00 - Cold Formed Metal Framing: Exterior framing.
 - 2. Section 06 10 00 - Rough Carpentry.
 - 3. Section 07 27 26 - Fluid-Applied Membrane Air Barriers: Vapor retarders.

1.3 REFERENCE STANDARDS

- A. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations; 2018.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- G. ASTM C727 - Standard Practice for Installation and Use of Reflective Insulation in Building Constructions; 2019.
- H. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2019.
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J. ASTM C1104/C1104M - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation; 2019.
- K. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2021.
- L. ASTM C1321 - Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction; 2015.
- M. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).
- N. ASTM C1744 - Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Commercial/Industrial Building Construction; 2019.

- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- P. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- Q. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.
- R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.
- S. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Technical data and installation instructions for each type of insulation product specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization
 - a. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread Index: Maximum 25.
 - 2) Smoke Developed Index: Maximum 450.
 - b. Fire Resistance Ratings: Per ASTM E119.
 - c. Combustion Characteristics: Non-combustible per ASTM E136.
 - 2. Underwriter's Laboratories UL 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of work.
 - 1. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
- C. Environmental Requirements:
 - 1. Manufacture extruded polystyrene with HCFC or other CFC free blowing agents. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
 - 2. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect Foam Plastic Board Insulation:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.7 PROJECT CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Sequence work to ensure fireproofing and firestop materials are in place before beginning work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. CertainTeed Corporation: www.certainteed.com/building-insulation.
 2. DuPont de Nemours, Inc.: www.dupont.com.
 3. Hunter Panels: www.hunterpanels.com.
 4. Johns Manville; a Berkshire Hathaway company: www.jm.com.
 5. Kingspan Group: www.kingspan.com/us/en.
 6. Knauf Insulation: www.knaufinsulation.com.
 7. Owens Corning: www.owenscorning.com/en-us/insulation/commercial.
 8. Rmax, a subsidiary of the Sika Corporation: www.rmax.com.
 9. Rockwool A/S: www.rockwool.com/north-america.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 EXTRUDED POLYSTYRENE FOAM BOARD

- A. Extruded Polystyrene Foam Board: ASTM C578, Type IV.
 1. Basis of Design Products:
 - a. Styrofoam Cavtymate Plus manufactured by DuPont de Nemours, Inc.
 - b. GreenGuard manufactured by Kingspan Group.
 - c. Foamular CW25 manufactured by Owens Corning.

2.3 POLYISOCYANURATE FOAM PLASTIC BOARD

- A. Polyisocyanurate Board, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.
 1. Basis of Design Products:
 - a. Thermax manufactured by DuPont de Nemours, Inc.
 - b. Xci manufactured by Hunter Panels.
 - c. ECOMAXci manufactured by Rmax, Inc.
 2. Fire Propagation Characteristics: Pass NFPA 285 testing as part of an approved assembly.

2.4 GLASS MINERAL FIBER INSULATION

- A. Glass Mineral Fiber Batt, Unfaced: ASTM C665, Type I (unfaced); with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
 1. Basis of Design Products:
 - a. CertaPro manufactured by CertainTeed Corporation.
 - b. Guardian Building Products, Inc. (Bought by Knauf)
 - c. Johns Manville; a Berkshire Hathaway company.
 - d. EcoBatt with ECOSE manufactured by Knauf Insulation.
 - e. PINK Next Gen Fiberglas manufactured by Owens Corning.

- B. Glass Mineral Fiber Batt, Kraft Faced: ASTM C665 , Type II (nonreflective faced), Class A (faced surface with a flame spread index of 25 or less); Category 1 (membrane is a vapor barrier).
 - 1. Basis of Design Products:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. EcoBatt with ECOSE manufactured by Knauf Insulation.
 - d. PINK Next Gen Fiberglas manufactured by Owens Corning.
- C. Glass Mineral Fiber Board:
 - 1. Basis of Design Products:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Earthwool manufactured by Knauf Insulation.
 - d. Fiberglas 700 Series Board manufactured by Owens Corning.
 - 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke Developed: 0.
 - 3. Thermal Resistance:
 - a. 2" and less R value/1 inch at 75 °F: 4.2 h ft² °F/Btu per ASTM C518.
 - b. 2" and greater R value/1 inch at 75 °F: 4.3 h ft² °F/Btu per ASTM C518.
 - 4. Water Vapor Permeance: 27.2 Perm minimum.
 - 5. Moisture Absorption: 1% maximum per ASTM C1104/C1104M.
 - 6. Fungi Resistance: Zero mold growth per ASTM C1338.
 - 7. Corrosive Resistance:
 - a. Steel per ASTM C665: Pass.
 - b. Stainless Steel per ASTM C795: Pass.

2.5 ROCK MINERAL FIBER INSULATION

- A. Rock Mineral Fiber Blanket: ASTM C665, Type I, complying with ASTM E136 smoke developed and flame spread of 0.
 - 1. Basis of Design Products:
 - a. Thermafiber UltraBatt manufactured by Owens Corning.
 - b. ComfortBatt manufactured by Rockwool A/S.
 - 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke developed: 0.
 - 3. Thermal Resistance: To ASTM C518.
 - 4. Density: 2 lbs/cu ft to ASTM C167.
- B. Rock Mineral Fiber Board: ASTM C612, Type IVB.
 - 1. Basis of Design Products:
 - a. Thermafiber manufactured by Owens Corning.
 - b. CavityRock manufactured by Rockwool A/S.
 - 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke Developed: 0.

3. Thermal Resistance:
 - a. 2" and less R value/1 inch at 75 °F: 4.2 h ft² °F/Btu per ASTM C518.
 - b. 2" and greater R value/1 inch at 75 °F: 4.3 h ft² °F/Btu per ASTM C518.
4. Water Vapor Permeance: 27.2 Perm minimum
5. Moisture Absorption: 1% maximum per ASTM C1104/C1104M.
6. Fungi Resistance: Zero mould growth per ASTM C1338.
7. Corrosive Resistance:
 - a. Steel per ASTM C665: Pass.
 - b. Stainless Steel per ASTM C795: Pass.

2.6 INSULATION FASTENERS

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.7 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Glass Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame spread and smoke developed indexes of 5, per ASTM E84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.

- B. Board and Batt Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
 - 1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Do not seal joints in board insulation. Remove projections that interfere with placement.
 - 2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- C. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 05 00 - Common Work Results for Masonry.
 - 2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.
- D. Framed Construction, Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3 inch (76 mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal framed wall cavities where cavity heights exceed 96 inches (2,438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 6. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - a. Glass Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu ft (40 kg/cu m) .
 - b. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- E. Curtain Wall: Install board insulation in curtain wall construction according to curtain wall manufacturer's written instructions.
 - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
 - 2. Install insulation to fit snugly without bowing.
- F. Reflective Insulation: Install sheet reflective insulation according to ASTM C727.
 - 1. Install sheet radiant barriers according to ASTM C1744.
 - 2. Install interior radiation control coating system according to ASTM C1321.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

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SECTION 07 42 13 - METAL WALL PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concealed fastener metal wall panels as part of the assembly.
 - 2. Modular metal wall panel system consisting of aluminum panels in a rainscreen application.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 05 40 00 - Cold Formed Metal Framing.
 - 2. Section 07 21 00 - Thermal Insulation: Batt and board insulations under metal wall panels.

1.3 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Texas with experience in the design of metal composite wall panels as part of curtainwalls and aluminum storefront systems to design and coordinate the cladding assembly using performance requirements and design criteria indicated.
- B. All Cold-Formed Metal Framing for Metal Wall and Soffit Panels to be designed by a Professional Engineer licensed in the State of Texas per Section 05 40 00 - Cold Formed Metal Framing.

1.5 SYSTEM REQUIREMENTS

- A. Modular Metal Panel System: Rainscreen design consisting of dry seal joinery designed, attachment system components, and associated necessary to minimize water penetration and induce air circulation in the space behind the panel system. Moisture weeping trim at panel base details allows water to drain out of the system.

1.6 SUBMITTALS

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings: Provide shop drawings prepared by manufacturer or manufacturer's authorized dealer. Include full elevations showing openings and penetrations. Include details of each condition of installation and attachment. Provide details at a minimum scale 3-inch per foot of all required trim and extrusions needed for a complete installation.
 - 1. Include data indicating compliance with performance requirements.
 - 2. Indicate points of supporting structure that must coordinate with modular metal panel system installation.
- C. Samples:
 - 1. One (1) ft long sample of each listed panel, including clips (if applicable) & fasteners. Indicate perforation pattern where applicable.
 - 2. Minimum 2" x 4" chip of specified finish.
- D. Qualification Information: For Installer and Installer's field supervisor.

- E. Warranty: Manufacturer's sample warranty as specified.

1.7 DELIVERY AND STORAGE

- A. All panels shall be delivered with appropriate packaging to provide protection against transportation damage. Materials damaged in shipping or storage shall not be used.
- B. Store all materials and accessories above ground on well-skidded platforms. Store under waterproof covering. Provide proper ventilation to panels to prevent condensation build-up between panels.

1.8 COORDINATION

- A. Coordinate work with installation of associated metal flashings and manufactured roof panels.
- B. General contractor shall coordinate with all subcontractors including masonry, waterproofing membrane, sheathing work, and framing to ensure walls are plumb and ready to accept fasteners and panel systems.
- C. Pre-construction meeting required with the Owner and the Architect. Representatives from all associated trades shall attend to coordinate arrival, delivery, and installation of products and materials.

1.9 WARRANTY

- A. Warrant the work specified herein for five years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship.
- B. Provide a manufacturer's thirty year finish integrity warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Uninsulated Metal Wall Panels:
 - a. Berridge Manufacturing Company: www.berridge.com.
 - b. CENTRIA, a Nucor company: www.centria.com.
 - c. Fabral: www.fabral.com/systems/commercial.
 - d. Metl-Span, an Nucor company: www.metlspan.com.
 - e. PAC-CLAD, a Carlisle Construction Materials brand: www.pac-clad.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Uninsulated Metal Panels:
 - 1. Concealed-Fastener Metal Wall Panels (MPU-1):
 - a. Basis of Design: HR-16 by Berridge Manufacturing Co..
 - b. Panel Coverage: 16 inch.
 - c. Panel Height: 378 inch.
 - d. Finish: Two-Coat Fluoropolymer: 0.2 mil (0.005 mm) primer with a 0.8 mil (0.020 mm) 70 percent PVDF fluoropolymer color coat containing metal flakes, and a 0.5 mil (0.013 mm) 70 percent PVDF fluoropolymer clear coat, AAMA 2605.
 - e. Color: Zinc Grey.
 - 2. Concealed-Fastener Metal Wall Panels (MPU-2, MPU-3):
 - a. Basis of Design: FW-1025 manufactured by Berridge Manufacturing Co..
 - b. Panel Coverage: 101/4 inch.

- c. Finish: Two-Coat Fluoropolymer: 0.2 mil (0.005 mm) primer with a 0.8 mil (0.020 mm) 70 percent PVDF fluoropolymer color coat containing metal flakes, and a 0.5 mil (0.013 mm) 70 percent PVDF fluoropolymer clear coat, AAMA 2605.
 - d. Color:
 - 1) MPU-2: Honey Walnut.
 - 2) MPU-3: Dark Bronze.
 - 3. Concealed-Fastener Metal Wall Panels (MPU-4):
 - a. Basis of Design: Brake Metal as manufactured by AmeriClad.
 - b. Finish: Kynar 500.
 - c. Color: SRI -58.
 - 4. Concealed-Fastener Metal Wall Panels (MPU-5):
 - a. Basis of Design: FW-120 as manufactured by MBCI.
 - b. Panel Coverage: 12 inches (305 mm).
 - c. Panel Length: Refer to Drawings,
 - d. Finish: Two-Coat Fluoropolymer: 0.2 mil primer with a 0.8 mil 70 percent PVDF fluoropolymer color coat containing metal flakes, and a 0.5 mil 70 percent PVDF fluoropolymer clear coat, AAMA 2605.
 - e. Color: To match existing.
 - 5. Soffit Panel (SFT-1):
 - a. Basis of Design: "Thin Line" manufactured by Berridge Manufacturing Co.
 - b. Panel Coverage: 3-5/8 inch.
 - c. Vented.
 - d. Finish: Two-Coat Fluoropolymer: 0.2 mil (0.005 mm) primer with a 0.8 mil (0.020 mm) 70 percent PVDF fluoropolymer color coat containing metal flakes, and a 0.5 mil (0.013 mm) 70 percent PVDF fluoropolymer clear coat, AAMA 2605.
 - e. Color: Honey Walnut.
 - f. Pattern: To match existing.
- B. Accessories:
 - 1. Zees: 16 gauge minimum thickness galvanized steel, 2 inch rise minimum, or as required to align with existing conditions.
 - a. Thermally Broken Zee Strips as manufactured by Cladators for metal wall panels attached to building.
 - 2. Sub-Girt Fasteners: Stainless Steel screws to meet application.
 - 3. Concealed Fasteners: Stainless Steel screws supplied or recommended by panel manufacturer to suit application.
 - 4. Metal Trim at Siding Panels: 0.060 inch thick pre-finished aluminum sheet, matching finish type and color of siding panels.
 - 5. Closures: 0.060 inch thick aluminum sheet, mill finish.
 - 6. Separate dissimilar metals with asphalt-saturated building felt or a bituminous coating to prevent galvanic action.

PART 3 EXECUTION

3.1 EXAMINATION OF MODULAR METAL PANEL SYSTEM

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.

2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
 - a. Verify that air or water resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel as required by manufacturer's written recommendations.

3.3 METAL WALL AND SOFFIT PANEL INSTALLATION

- A. Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal composite material panels.
 2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self tapping screws. Do not begin installation until air or water resistive barriers and flashings that will be concealed by metal composite material panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal composite material panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self tapping screws. Fasten flashings and trim around openings and similar elements with self tapping screws.
 8. Provide weathertight escutcheons for pipe and conduit penetrating panels.
- B. Fasteners:
 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 1. Include attachment to supports, panel to panel joinery, panel to dissimilar material joinery, and panel system joint seals.
- E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
 1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00.
 2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.

3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.
- F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed and returned flanges of wall panels to panel clips with standard fasteners.
 1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00 "Joint Sealants".
 2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.
- G. Subgirt and Spline Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard subgirts and splines that provide support and complete secondary drainage assembly, draining to the exterior at horizontal joints. Attach metal composite material wall panels by interlocking perimeter extrusions attached to panels with subgirts and splines. Fully engage integral subgirt and spline gaskets and leave horizontal and vertical joints with open reveal. Terminate edge of panels flush with perimeter extrusions.
 1. Install wall panels to allow individual panels to free float and be installed and removed without disturbing adjacent panels.
 2. Do not apply sealants to joints unless otherwise indicated.
- H. Track Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal tracks and vertical tracks that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.
 1. Attach routed and returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
 2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
 3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 4. Do not apply sealants to joints unless otherwise indicated.
- I. Rainscreen Principle Installation: Install using assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
 1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
 2. Do not apply sealants to joints unless otherwise indicated.
- J. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; provide types recommended in writing by metal composite material panel manufacturer.
- K. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA Architectural Sheet Metal Manual. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), nonaccumulative, on level, plumb, and location lines as indicated, and within 1/8 inch (3 mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
- B. Water Spray Test: After installation, test area of assembly directed by Architect for water penetration according to AAMA 501.2.
- C. Manufacturer Field Service: Engage a factory authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.
- D. Metal composite material wall panels are considered defective if they do not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

SECTION 07 52 20 - MODIFIED BITUMEN "COOL ROOF" MEMBRANE ROOFING SYSTEM AT REROOFING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Providing coordination for the entire roofing assembly, including, but not limited to:
 - 1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
 - 2. Modified bitumen membrane roofing
 - 3. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00).
 - 4. Work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
- B. It is the intent of this Section that the Work shall:
 - 1. provide a watertight facility;
 - 2. conform to all applicable building code requirements and of authorities having jurisdiction;
 - 3. include Section 07 62 00, Roof Related Sheet Metal as part of the Work of this Section; and be performed to obtain a single responsibility total system warranty.
- C. Work and materials hereinafter specified shall be best of kind described and, unless specified otherwise, shall be new and of best quality. All roofing materials utilized in performance of each type of work shall be the products of one (1) manufacturer or supplier.

1.3 RELATED WORK

- A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.4 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. C920, Standard Specification for Elastomeric Joint Sealants
 - 2. D41, Standard Specification for Asphalt Primer Used in Roofing, Damproofing, and Waterproofing
 - 3. D312, Standard Specification for Asphalt Used in Roofing
 - 4. D2178, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
 - 5. D4479, Standard Specification for Asphalt Roof Coatings - Asbestos-Free
 - 6. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free
 - 7. D4601, Standard Specification for Asphalt-Coated Glass Fiber Sheet Used in Roofing
 - 8. D5147, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material

9. D4897, Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
 10. D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
- B. ASCE-7-16 Wind uplifts requirements for geographical area.
- C. Federal Specifications (FS)
1. SS-R-620B
 2. TT-S-00230C
- D. National Roofing Contractors Association (NRCA)
1. Roofing and Waterproofing Manual
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1. Architectural Sheet Metal Manual
- F. International Building Code
- G. Underwriters' Laboratories (UL)
1. Fire Hazards Classifications

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout, and accessories to be used in the Work.
- B. Certifications:
1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system.
 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
 3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
 4. Installer shall submit written certification that there are no undocumented workers being employed by them or by any subcontractor on this project and that all workers on this project are covered by workmen's compensation.
 5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
 6. Manufacturer's written certification of approval / acceptance of these specifications and details.
 7. Warranty: Submit letter from manufacturer signed by agent authorized to do so, stating acceptance of warranty as specified and detailed.
- C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- D. Shop Drawings: Furnish from copies of the manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", fourth edition.
1. Furnish for approval any proposed details which differ from those included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
 2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.

- E. Samples:
 - 1. Submit sample copy of job specific warranty that is to be issued upon project completion.
 - 2. Submit mock-up of all fabricated sheet metal items.
 - 3. Submit 12 inch x 12 inch sample of all types of roof membranes to be installed.
- F. Temperature Charts: Bitumen heating devices 24 hour temperature charts.
- G. Test Reports: Bitumen manufacturer's test reports relative to the following for each batch of bitumen furnished:
 - 1. Softening Point: ASTM D312.
 - 2. Flashpoint: ASTM D92.
 - 3. Acceptable Bitumen Temperature: As recommended by the bitumen manufacturer and EVT label on containers.
 - 4. Thermometers: Two (2) hand held, "8F" thermometers complying with ASTM E1 to Architect for his checking kettle temperature.
- H. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
 - 1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
 - 2. Maintenance Procedures: Three (3) copies of manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.

1.6 PROJECT CONDITIONS

- A. Weather Condition Limitations: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements. Roofing application with moisture present will not be accepted. Do not attempt construction of the roofing system when the reported or calculated dew point are within three (3) degrees of each other
- B. Do not allow waste products, petroleum, grease, oil solvents, mineral oil, and other contaminants to come into contact with the roofing system before or during installation. Advise Owner if there is a possibility of his facility emitting such contaminants in the future.

1.7 INSPECTIONS / TESTS

- A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
 - 1. Architect Inspections: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
 - 2. Manufacturer Inspections:
 - a. An inspection shall be made by a representative of the material manufacturer at appropriate intervals during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
 - b. The authorized material manufacturer's field representative shall be responsible for:
 - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.

- 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
 - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
 - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.
- B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
 2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
 3. Non compliance with contractor requirements will result in the Architect/Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor.

1.8 QUALITY ASSURANCE

- A. Applicator:
1. Applicator shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
 2. Applicator shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
 3. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.
 4. Applicators shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Contractor as his agent.
 5. All workmen shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
 6. Contractor shall ensure that base fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
 7. Roofing contractor must have reached the highest level of qualifications from the manufacture they are providing material for (i.e. Master Select contractor).
- B. Regulatory Requirements:
1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
 2. Roofing system shall be installed in accordance with ASCE-7-10 wind uplift requirements for geographical location exposure B, 160 MPH 3-second gust wind speed zone and risk category III based on IBC building code requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation

3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.
 1. Zone 1 Field 78.1 psf or as otherwise indicated by Structural
 2. Zone 2e Perimeter 78.1 psf or as otherwise indicated by Structural
 3. Zone 2n Perimeter 114.0 psf or as otherwise indicated by Structural
 4. Zone 2r Ridge 114.0 psf or as otherwise indicated by Structural
 5. Zone 3e Corner 114.0 psf or as otherwise indicated by Structural
 6. Zone 3r Ridge Corner 135.5 psf or as otherwise indicated by Structural
- C. Texas State Board of Insurance Windstorm Regulations: Owner will provide inspector to meet all requirements. Contractors to coordinate all applicable roof inspections with Owners Inspector.
- D. Laboratory Testing and Samples:
 1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
 2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Contractor shall assume all costs for extraction and patch of all samples.
 3. Re-tests for work which fail initial tests or contractor shall pay inspections.
 4. Contractor shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.
- E. Installation:
 1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
 2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Contractor's Association.
 3. It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of it. Any drawings supplied are for reference only.
 4. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
 5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
 6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all contractors' equipment and materials removed from the site.

1.9 PERFORMANCE REQUIREMENTS

- A. Texas State Board of Insurance Windstorm Regulations: Owner will provide inspector to meet all requirements. Contractors to coordinate all applicable roof inspections with Owners Inspector.
- B. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.

- C. Contractor shall ensure that base fastener pull out resistance tests on new lightweight insulating concrete fill were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

1.10 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. Coordinate material storage with school Principal.
- B. Manufacturer's packaging and / or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.
- C. Products liable to degrade as a result of being frozen shall be maintained above 40 degrees F in heated storage.
- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.
- E. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- F. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.12 PRECAUTIONS

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.
- B. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.
- C. If torches are used, Contractor shall maintain a three (3) hour fire watch after completion of torching of each day's work. Provide a 20 lb. fire extinguisher near torch at all times. Use a thermal infrared thermometer to monitor all roof areas.
- D. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above mentioned items.

1.13 WARRANTY

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
 - 1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
 - 2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
 - 3. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.
- C. Make arrangements with the materials manufacturer to provide required inspections for issuance of warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer.
- B. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
- C. All materials used on the project shall be asbestos free.

2.2 APPROVED PRODUCTS/MANUFACTURERS

- A. Unless noted otherwise, specifications are based on products of named manufacturers but should not preclude the Contractor from using other manufacturers who produce products that meet or exceed the specifications. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
 - 1. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the manufacturer.

2. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
 3. All materials used on the project shall be asbestos free.
- B. Approved Manufactures:
1. Holcim Elevate; Nashville, TX (800) 428-4442
 2. Siplast, Inc., Irving, Texas; (972) 869-0070
 3. Soprema, Wadsworth, OH; (800) 356-3521
 4. Johns Manville, Denver, CO; (800) 654-3103

2.3 APPROVED PRODUCTS/MANUFACTURERS

- C. Unless noted otherwise, specifications are based on products of named manufacturers but should not preclude the Contractor from using other manufacturers who produce products that meet or exceed the specifications. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
4. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the manufacturer.
 5. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
 6. All materials used on the project shall be asbestos free.
- D. Approved Manufactures:
1. Holcim Elevate; Nashville, TX (800) 428-4442
 2. Siplast, Inc., Irving, Texas; (972) 869-0070
 3. Soprema, Wadsworth, OH; (800) 356-3521
 4. Johns Manville, Denver, CO; (800) 654-3103

2.4 ROOFING SYSTEM ASSEMBLY/PRODUCTS

- A. Modified Base Sheet: A fiberglass reinforced, Styrene-Butadiene-Styrene (SBS) modified asphalt coated sheet, having an average weight of 28 pounds per square.
1. Approved Product:
 - a. Holcim Product: MB Base, base sheet
 - b. Siplast Product: Para Base, base sheet
 - c. Soprema Product: Sopra-G, base sheet
 - d. JM Product: Perma Ply 28, base sheet
- B. Dry Sheathing Paper: (For use as a slip sheet) Rosin coated, 5 lbs. per 100 sq. ft.

2.5 ROOF MEMBRANE ASSEMBLY

- A. System Description: A roof membrane assembly consisting of two (2) plies of a prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the

entire roof system. Contractor option to install using hot asphalt “mopped”, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.

1. **Hot Asphalt Applied Modified Bitumen Base Ply:** Approximately 90 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
 - a. Approved Product:
 - 1) Holcim Product: SBS Base
 2. Siplast Product: Paradiene 20
 - 2) Soprema Product: Elastophene Sanded 2.2
 - 3) JM Product: DynaBase
2. **Torch Applied Modified Bitumen Base Ply:** Approximately 120 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
 - a. Approved Product:
 - 1) Holcim Product: SBS Glass Torch Base
 2. Siplast Product: Paradiene 20 TG
 - 2) Soprema Product: Elastophene Flam
 - 3) JM Product: DynaWeld Base
3. **Hot Asphalt Applied Modified Bitumen Finish Ply:** Approximately 130 mil or better high-performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:

Approvals: UL Approved, FM Approved (products shall bear seals of approval)

Surfacing: White synthetic chips

Solar Reflectance (avg.): greater than 3 year aged .75

Thermal Emittance (avg.): greater than 3 year aged .75

Solar Reflectance Index (avg.): greater than 3 year aged 64

 - a. Approved Product:
 - 1) Holcim Product: SBS Glass FR Ultrawhite
 - Siplast Product: Paradiene 30 FR BW
 - 2) Soprema Product: Elastophene LS FR GR SG
 - 3) JM Product: DynaGlas FR CR G
4. **Torch Applied Modified Bitumen Finish Ply:** Approximately 140 mil or better high-performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
 - a. Approvals: UL Approved, FM Approved (products shall bear seals of approval)
 - b. Surfacing: White synthetic chips
 - c. Solar Reflectance (avg.): greater than 3 year aged .75
 - d. Thermal Emittance (avg.): greater than 3 year aged .75
 - e. Solar Reflectance Index (avg.): greater than 3 year aged 64
 - f. Approved Product:
 - 1) Holcim Product: SBS Glass FR Torch Ultrawhite

- 2) Siplast Product: Paradiene 30 FR TG BW
- 3) Soprema Product: Elastophene Flam LS FR GR SG
- 4) JM Product: Dynaweld Cap FR CR

5. Stripping Ply: Same as roof system base ply.

2.6 FLASHING MEMBRANE ASSEMBLY

- A. A flashing membrane assembly consisting of two (2) plies of reinforced, polymer modified asphalt membrane (foil face flashing membrane can be used as substitute):
 1. Modified Bitumen Flashing Sheet: Same as roof system finish ply.
 2. Modified Bitumen Foil Faced Flashing Sheet (Substitute):
 - a. Holcim Product: SBS Metal Flash AL
 - b. Siplast Product: "Aluminum" Veral
 - c. Soprema Product: Sopralast 50 TV "Alu"
 - d. JM Product: DynaClad AL
 3. Reinforcing Ply: Same as roof system base ply.

2.7 ROUGH CARPENTRY

- A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

2.4 ROOFING SHEET METAL

- A. Refer to Section 07 62 00, Roof Related Sheet Metal.

2.5 ROOF INSULATION

- A. Roofing Insulation:
 1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
 2. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 and Federal Specification Type 2 Class 2, with a 20-psi minimum compressive strength. Insulation shall be surfaced on both sides with a double coated non-asphaltic Non-Organic coated fiberglass facers. Thickness shall be a minimum of 4.4" (divided in two layers of 2.2") over all conditioned air space, see drawings for details. Board sizes shall be 48" x 96" x 1/2" for mechanically attached and 48" x 48" x 1/2" for adhered. Approved product shall be RESISTA as manufactured by Firestone or pre-approved equal.
 3. Recover Board (Unless noted otherwise): Glass-Faced Gypsum Roof Board equal to UL rated Type X "Dens Deck Prime" as produced by Georgia-Pacific. Board sizes shall 48" x 48" x 1/2" for adhered or as indicated on drawings for roof assembly. Provide as required by manufacture recommendation primer for Roof System. Approved substitute, SECUROCK by USG.
 4. Tapered ISO. Insulation: Factory cut 48 inches x 48 inches polyisocyanurate board cut to 1/4 inch per foot slope; thickness varies; ASTM C1289, UL Class A, Type 2 Class 2 with a 20-psi minimum compressive strength. Approved product shall be Tapered RESISTA manufactured by Firestone or pre-approved equal. Provide 1/2-inch recovery board similar to that specified above over tapered polyisocyanurate board insulation if used.

5. Tapered Edge Strip: 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Approved material shall be as manufactured by Cant Products or pre-approved equal.

2.6 ROOFING ACCESSORIES

- B. Membrane Roofing Adhesives other than torch option:
 1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
 - a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
- C. Insulation Adhesives:
 1. Low Rise foam as per manufacturers requirements.
- D. Bituminous Cutback Materials:
 1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.
 2. Plastic Cement: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
 3. Flashing Cement: A heavy-bodied all-weather trowel grade mastic, used as a base for laying-up cold process flashing membrane where fast setting adhesives are required.
- E. Sealants: A single component, high performance, elastomeric sealant conforming to ASTM D232 or ASTM C920 requirements. Acceptable types are as follows:
 1. Sonolastic NP 1 manufactured by Sonneborn Building Products; Minneapolis, MN (612) 835-3434
- D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.
- E. Walkpads / Protection Pads: Provide cut sections of granule surfaced polyester reinforced modified bitumen sheet, such as "Dyna Tred Plus".
 1. Walk pads shall have contrasting granule color from surfacing.
 2. Provide walk pads shall be installed at point of roof access, at service points of all roof mounted equipment requiring periodic maintenance.
 3. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
 4. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all roof top doors and openings.
- F. Fasteners:
 1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.
 2. Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
 3. Fastener for Wood and Insulation (over steel decks): Shall be a minimum #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a

fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal. Stainless Steel 304 when used with ACQ treated lumber.

4. Nails: Stainless Steel ring shank, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head.
 5. Iron-Lok Toggle: Shall be a toggle bolt with minimum 0.215 inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wing span, with wing activated adhesive and pressure plate, as manufactured by Olympic Manufacturing Group, Inc.
- G. Liquid Flashings: One-Part Liquid Flashing is a one-component polyurethane / bitumen resin that provides a liquid flashing solution for asphaltic roofing systems. Utilize fabric in three part system at all penetrations.

2.9 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the manufacturer.
1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
 2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per manufactures recommendations.
 - a. Approved Substitute Soprema's "Sopra Joint". Install as per manufactures recommendations.
 3. Sealant Backer Rod: Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
 4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to Section 07 72 00, Roof Accessories.
 5. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.
 6. Termination Bar:
 - a. Material: Extruded aluminum bar with lip profile.
 - b. Size: 0.090 inch thick by 3/4 inch wide with 3/16 inch lip width and a 45 degree lip angle, factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
 - c. Approved Product/Manufacturer: "LIPTB 06" manufactured by Olympic Manufacturing Group, Inc., or approved equal.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

- A. Environmental Requirements:

1. Apply roofing in dry weather.
2. Do not apply roofing when ambient temperature is below 45 degrees F.
3. Refer to manufacturers recommendations.

3.2 ROOFING AND FLASHING - GENERAL

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow installation of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Application of materials shall be in strict accordance with the manufacturer's recommendations except where more stringent requirements are shown or specified. In the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.
- D. General Installation:
 1. Protect adjacent areas with tarpaulin or other durable materials.
 2. Contractor shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.
 3. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.
 4. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. All Kynar 500 or Hylar 5000 finished metal shall be buff sanded on the surface which is to be primed prior to the application.
 5. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
 6. All surfaces/substrates shall be clean and dry prior to application of materials. Roof deck substrates shall be inspected for moisture in accordance with the manufacturer's recommendations. Architect's representative shall witness inspection. Roofing installed before inspection by Architect's representative shall be removed to allow inspection.
 7. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the substrate. Gravel or debris between the substrate and plies is not acceptable.
 8. Ambient temperature shall be 45 degrees F and rising.
 9. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. Kettle shall be kept a minimum of 20 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not directed towards freshly painted or anodized surfaces, glass or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit. Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight (8) inches from top of kettle. All kettles are to have afterburners installed to reduce fume emissions.
 10. Asphalt Bitumen Heating: Heat and apply bitumen in accordance with equiviscous temperature method ("EVT Method") as recommended by the manufacturer.

- Discard bitumen that has been held at temperature, exceeding finished blowing temperature (FBT) for a period exceeding three hours. Do NOT heat bitumen to a temperature higher than 25 degrees F (14 degrees C) below flash point.
11. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F.
 12. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.
 13. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
 14. Circulate bituminous materials, do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers.
 15. Keep kettle lid closed except when adding bitumen.
 16. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying felt and membrane.
 17. Dry voids of felt on felt are not acceptable.
 18. Primed cant strips shall be installed at the intersection of the deck and the vertical surfaces.
 19. All flashings shall be mechanically top-fastened with a termination bar a minimum of six (6) inches on center at the top leading edge, and be a minimum of eight (8) inches in height above the finished membrane height.
 20. On slopes greater than one (1) inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
 21. Correct all errors in application the same work day they occur, including voids, fishmouths, dry laps or spots, wrinkles, ridges, blisters, bare spots, improper application, physical damage and all work not meeting specifications.

3.3 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building in accordance with FM Global 1-49 securement requirements. All deck penetrations (soil stacks, mechanical curbs, etc.) shall receive wooden nailers stacked minimum 3/4 inch above designed deck thickness. MCA and MCQ only.
- B. All Construction: Nailers shall be the same height as the finished height of the insulation layer. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer, and be spaced at three (3) feet on center maximum or as required by FM Global 1-49 requirements. Provide nailers at all penetrations. Install/Raise all curbs, etc, a minimum of ten (10) inches above roof deck.

3.4 SUBSTRATE PREPARATION

- A. Lightweight Insulating Concrete Deck Systems: Nailable fills shall receive base sheet properly fastened with suitable FM approved fasteners and installed in accordance with ASCE 7 wind uplift pressure calculations.
 1. Damaged lightweight fill decks shall be removed back to solid material. Fill holes, bird baths, etc., in deck using Zonopatch; or equal by approved manufacturer.

3.5 APPLICATION OF BASE SHEET AT AND TECTUM DECKS

- A. Lightweight concrete and Tectum decks shall be covered with a base sheet, mechanically fastened as follows:
 1. Install in accordance with manufacturer's current published application instructions and to meet ASCE-7 wind uplift requirements. Fasteners and fastening patterns

shall be determined by building height, pull out values from lightweight insulating concrete decks (more stringent applies), location and geographical area of the United States. It is the contractor's responsibility to consult current ASCE-7 publications, literature, and bulletins that are in effect at the time of this project. Submit perimeter, field and corner fastening patterns and cite all ASCE-7 data pertaining to the fastening pattern to the Architect for review.

3.6 APPLICATION OF INSULATION

- A. General:
 - 1. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application.
 - 2. Precautions: The surface of the insulation must not be ruptured or damaged prior to installation of the roof membrane. Replace damaged boards.
 - 3. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
 - 4. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
 - 5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
 - 6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required NRCA standards.
- B. (Steel decks); Specified layers of rigid insulation shall be mechanically fastened to the steel deck meeting ASCE-7 wind uplift requirements as dictated by wind zone applicable to location of project. Fasteners and fastening patterns shall be determined by building height, location and geographical area of the United States. The specified recovery board, the top surface of the underlying layer of insulation shall be adhered with roofing manufacturers low rise foam adhesive, and subsequent layers of insulation shall be applied using offset joints, so that all individual insulation layers joints are offset a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place. It is the contractor's responsibility to consult current publications, literature, and bulletins of current codes and the manufacturer that are in effect at the time of this project.
- C. (LWIC and Tectum decks); All layers of insulation or specified recovery board, the top surface of the underlying layer of insulation or base sheet shall be adhered with roofing manufacturers low rise foam adhesive, and subsequent layers of insulation shall be applied using offset joints, so that all individual insulation layers joints are offset a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.

3.7 ROOF MEMBRANE INSTALLATION

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic

- powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- D. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.
1. Apply all layers of roofing so that water flows over or along lap seams, but never against laps.
 2. Mechanically attached and heat weld the seams or fully bond the base ply to the recover board with torch, hot asphalt. Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the applicator. Stagger end laps a minimum of three (3) feet.
 3. Fully bond the finish ply to the base ply with torch, or hot asphalt. Each sheet shall have a minimum of three (3) inch side and six (6) end laps. Each sheet shall be applied directly behind the applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
 4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
 5. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out.
- E. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic color and adhesion.

3.8 ROOF FLASHING MEMBRANE INSTALLATION

- A. Flashing - General:
1. Flashings shall be installed using the manufacturer's flashing membrane, with length of run not to exceed manufacturer's recommendations.
 2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade wolmanized timber, and of the same thickness as any insulation to be used on the roof.
 3. Cant strips shall be installed at the intersection of the deck and/or all vertical surfaces. Prime all cants.
 4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
 5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
 6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height (seal top with three (3) coursing), extend a minimum of nine (9) inches onto the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.

7. Install flashing membrane in accordance with drawings and/or material manufacturer's guarantee requirements, whichever is the most stringent.
 8. Exert sufficient pressure on the flashing membrane to ensure the prevention of air pockets. This can be accomplished by using a damp, kitchen type sponge mop or a damp, heavy duty cotton nap paint roller.
 9. Prime all end laps of the flashing membrane with a uniform coating of the specified asphalt primer and allow to thoroughly dry prior to overlapping of adjoining sheets.
 10. Probe laps using a clean, heated roofing trowel and heat fuse dry laps of the flashing membrane to ensure a complete seal.
- B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)
- C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12 inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)
- D. Projection Flashings:
1. Plumbing Vents: Soil vent stack pipes shall receive lead flashings installed in accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack, and crimped down into the pipe to form a watertight seal. Projections shall be flashed as recommended by the roof membrane manufacturer. Strip-in flange with specified stripping ply and cap with finish ply. Provide flashing membrane target.

2. Square Projections: Strip in all flanges on square projections with specified stripping ply and cap with finish ply. Provide flashing membrane target. Provide tapered edge strips around base. Cricket up-side slope.
 3. Prime all flanges prior to setting in a bed of mastic. Install to manufacturer's specifications. Provide tapered edge strips around base as required. Cricket up-side slope.
 4. Round Projections: Strip in all flanges on round projections with specified stripping ply and cap with finish ply. Provide flashing membrane target.
 5. Prime all metal prior to setting in mastic. Install to manufacturer's specifications.
- E. Wall and Curb Flashings:
1. The flashing substrate shall be free of all dirt and loose material.
 2. $\frac{3}{4}$ " plywood is to be used at all parapets that receive wall flashings.
 3. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
 4. Starting on the roof at least six (6) inches from the roofside edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
 5. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.
 6. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
 7. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
 8. Cricket the up-side slope at all curb projections.
- F. Perimeter Edge Flashing: Refer to Section 07 62 00.
- G. Bleed out of flashing membrane: Broadcast bulk aluminum powder over all bitumen overruns on the flashing membrane surface while the bitumen is still hot to ensure a monolithic surface color. With approval of manufacturer, a premium glossy aluminum paint may be used.

3.9 OVERNIGHT SEAL / WATER CUT-OFF

- A. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
- B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

3.10 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the application of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.

- B. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.
- C. Sheet Metal: Refer to Section 07 62 00, ROOF RELATED SHEET METAL.

3.11 FIELD QUALITY CONTROL AND INSPECTIONS

- A. Roof cuts shall be performed and repaired at contractor's expense. Cuts shall be made in the areas as indicated by the Architect's representative. Send required roof cuts to roof membrane manufacturer for laboratory examination. Roof cuts required by the Architect's representative shall be furnished to the Architect's representative for testing.
- B. Remove not more than one (1) 12 inch x 12 inch cut per 5,000 square feet of roof area or fraction thereof.
- C. Field audit will follow criteria outlined in current roof membrane manufacturer's Reference Manual.
- D. Repair sampled areas with "feathered in" patch consisting of same number of plies as in the roof specification.
- E. Correct deficiencies in roof as prescribed in current roof membrane manufacturer's Reference Manual and as approved by Architect's Representative.

3.12 CLEANING AND PROTECTION

- A. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.
- B. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.
- C. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
- D. Remove bitumen stains from walls, walkways, and driveways.

END OF SECTION

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide flexible flashing where shown on drawings or required.

1.2 RELATED SECTIONS

- A. Section 04 20 00 – Unit Masonry

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Certification: Manufacturer's affidavit that materials used in Project contain no asbestos.
- C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS

- A. Flashing:
 - 1. Copper Laminated Flashing:
 - a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
 - 1) Modified asphalt compound coated.
 - 2) Asphalt saturated, waterproof glass fiber laminated fabric.
 - b. Approved Manufacturers:
 - 1) Advanced Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Sandell Manufacturing Company, Inc.
 - 4) York Manufacturing, Inc.
 - c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings
 - 2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of item

above):

- a. Glass fabric scrim bonded to a full sheet of copper for general thru-wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved seam tape.
 - b. Approved Product/Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Tuff as manufactured by Hohmann & Barnard, Inc. (No substitutions)
3. Membrane Flashing:
- a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer.
 - b. Approved Products / Manufacturers:
 - 1) "Air-Shield" manufactured by W.R. Meadows, Inc.
 - 2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
 - 3) "Blueskin TWF" manufactured by Henry Co.
4. Substrate Primer: as instructed by membrane manufacturer
5. Termination Bar: 1/8 inch thick by 1 inch minimum wide stainless steel, w/ pre-punched holes and self-tapping screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Flashing:
1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
 2. Application Guidelines - Install flashing at the following locations:
 - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
 - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, masonry wall cap flashing and masonry wall base flashing.
 3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
 4. Provide drip edge flashing at weep conditions with membrane flashing. Cut ¼" to ½" behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
 5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut ¼" to ½" behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
 6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.

7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
 8. Thru-Wall Flashing: Shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
 9. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
 10. Heads, Jambs and Sills: Flashing for heads and sills shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.
 11. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
 12. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
 13. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
 14. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
 15. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
 16. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
 17. Reglet Termination: Insert wedge into place and seal carefully with adhesive.
 18. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
 19. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full $\frac{1}{8}$ inch protective coating or mastic on all flashing faces.
- B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back $\frac{3}{4}$ inch from face of masonry.

3.2 APPLICATION

- A. Protect membrane from overexposure to direct sunlight.

- B. Follow manufacturer's recommendations for installation.
- C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

END OF SECTION 07 65 00

SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pre-finished galvanized steel gutters and downspouts.
 - 2. Precast concrete splash pads.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Metal downspout boots and downspout guards.

1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.
- C. Maintain one copy of each document on site.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on prefabricated components.
- C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- D. Samples: Submit two samples, 6 inch (150 mm) long illustrating component design, finish, color, and configuration.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- C. Prevent contact with materials that could cause discoloration, staining, or damage.

1.7 WARRANTY

- A. Manufacturer's Product Warranty:
 - 1. Manufacturer's standard 30-year finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
 - 2. Failure is defined to include, but not be limited to:
 - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
 - 3. Correction may include repair or replacement of failed product as outlined in Warranty Documents

4. Finish warranty and wind warranty shall be delivered by the Contractor to the Owner at the conclusion of project as part of project closeout documents.
- B. Contractor's Warranty:
 1. The Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the gutters, downspouts, and conductor heads will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
 2. Defects shall include, but not be limited to:
 - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
 - b. Leaking water or bitumen within building or construction.
 - c. Becoming loose from substrate / blocking.
 - d. Loose or missing parts.
 - e. Finish failure as defined above.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Gutters and Downspouts:
 - a. Alside, Inc: www.alside.com/.
 - b. ATAS International, Inc.: www.atas.com/.
 - c. Cheney Flashing Company: www.cheneyflashing.com/.
 - d. Drexel Metals Inc: www.drexmet.com/.
 - e. Hickman Edge Systems: www.hickmanedgesystems.com/.
 - f. Metal-Era, an MTL Company: www.metalera.com/.
 - g. SAF Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc: www.saf.com/persys/.
 2. Scupper and Collectors:
 - a. ATAS International, Inc.: www.atas.com/.
 - b. Metal-Era, an MTL Company: www.metalera.com/.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal.
 1. Finish: Shop pre-coated with modified silicone coating.
 2. Color: As indicated on Drawings.

2.3 COMPONENTS

- A. Basis of Design: Seal-Tite Industrial Gutter IG-B manufactured by Metal-Era.
- B. General Requirements:
 1. Minimum 24-gauge prefinished galvanized steel, formed in maximum 12 foot lengths.
 2. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
 3. Install all anchoring devices as outlined in manufacturer literature.
- C. Gutters:
 1. Profile as indicated on Drawings.
 2. Form in maximum lengths of 12 feet.

3. Supply Drip Edge at gutter.
 4. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing (PVC).
 5. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
 6. Gutter Straps and Supports: Minimum 3 per 12 foot length, 0.100 inch thick downspout straps: Strap type, like metal, match color.
- D. Downspouts:
1. Profile as indicated on Drawings.
 2. Downspouts: Minimum 24-gauge prefinished galvanized steel (match color).
- E. Scuppers and Collectors:
1. Profile as indicated on Drawings.
 2. Collector Heads: Minimum 24-gauge prefinished galvanized steel (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.
- F. Anchors and Supports:
1. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets, and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
 2. Anchoring Devices: As recommended by fabricator.
 3. Gutter Supports: 2 inch Wide Gutter Straps at 24 inches o.c., Wind Straps 6 feet o.c., 1/8 inch Stainless Steel Pop Rivets, and #10 by 2 inch Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer..
 4. Downspout Supports: Strap type, like metal, match color.
- G. Accessories:
1. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3,000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.
 2. Downspout Boots: Refer to Section 05 50 00 - Metal Fabrications.
 3. Downspout Guards: Refer to Section 05 50 00 - Metal Fabrications.

2.4 FABRICATION

- A. Form gutters and downspouts of profiles and size(s) indicated on Drawings.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

2.5 FINISHES

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as selected by Architect from manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

3.2 PREPARATION

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

3.3 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Slope gutters ____ inch per foot (____ mm/m) .
- D. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- E. Connect downspouts to downspout boots at ____ inches (____ mm) above grade. Grout connection watertight.
- F. Set splash pans under downspouts.

END OF SECTION 07 71 23

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 INSTALLATION RESPONSIBILITY

- A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.
- B. Coordinate the Work specified herein with the following Work:
 - 1. Roofing
 - 2. Roofing sheet metal
 - 3. Mechanical equipment
 - 4. Plumbing

1.3 REFERENCES

- A. Federal Specifications (FS)
 - 1. TT-S-00227E
- B. National Roofing Contractors Association (NRCA)
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.6 WARRANTY

- A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of finish
 - 2. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

- A. Frames:
1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
 - a. Minimum 18 gauge, and as engineered by manufacturer.
 - b. Minimum 18 gauge for curbs supporting HVAC units
 - c. Minimum 20 gauge for expansion joint curbs.
 2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
 3. Base Plates: Integral to frame and welded.
 4. Internally reinforced with galvanized 1 inch by 1 inch by 12 gauge angles for curbs exceeding 3 foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
 5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.
- B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.
- C. Curb Height: Minimum 8 inch above finished roof.
- D. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.
- E. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.
- F. Counterflashing: 24 gauge stainless steel
- G. Counterflashing Cap: Stainless steel.
- H. Cants:
1. Non-canted curb style installs either under or on top of metal decks with insulation.
 2. Cants shall be provided under Section 07 52 19 - Roofing
- I. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.
- J. Approved Manufacturers:
1. Custom Curb, Inc.
 2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Cannot be contractor built supports)

- A. Gas Pipe Supports:
 - 1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases; Model Type SS100RA for lines 2-1/2 inches and smaller, Model Type SS1000H with clevis and swivel hanger for lines 3 inches and larger.
 - 2. As manufactured by Advanced Support Products. PHP Systems Design and Miro Industries Inc. are approved equal.
- B. Electrical Conduit / Condensate Lines:
 - 1. Provide strut type support with recycled plastics and carbon black for UV protection bases, install with hold clips ordered as an accessory; Model Type SS500A with strut. Model Type SS1000H with clevis and swivel hanger for lines 3 inches and larger.
 - 2. As manufactured by Advanced Support Products. PHP Systems Design and Miro Industries Inc. are approved equal.
- C. Chill Water Lines:
 - 1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases (size as required); Model Type SS2000P with clevis and swivel hanger .
 - 2. As manufactured by Advanced Support Products. PHP Systems Design and Miro Industries Inc. are approved equal.
- D. Installation:
 - 1. Locate as indicated by Drawing at no greater than 8 feet-0 inches o.c.
 - 2. Provide protective traffic pads below each support, tacked in place with approved mastic or adhesive.
 - 3. Install hold down clips if indicated on the drawings or required.

2.4 ROOF TO ROOF EXPANSION JOINT

- A. Stainless Steel expansion joint covers on new wood curbs, as detailed on drawings and outlined the NRCA and SMACNA manual.

2.5 RETROFIT ROOF DRAINS

- 1. Retrofit Roof Drains: "Hercules RetroDrain" as manufactured by OMG, Inc. or Architect approved equal.
 - 2. Size: To match existing roof drain sizes
 - 3. Compliance:
 - a. ANSI / SPRI RD-1.
 - b. ULC / ORD-C790.4.
 - 4. Drain Body:
 - a. Material: 1-piece, 11-gauge (0.125-inch) spun aluminum.
 - b. Flange: 17-1/2-inch diameter.
 - 5. Drain Stem Length: 12 inches
 - 6. Flange Includes: Six 2-1/2-inch-long aluminum studs.
 - 7. Sump Area: Depressed.
- A. Strainer Dome:
 - 1. Material: Cast aluminum.
 - 2. Height: 7.25 inches.
 - 3. Outside Base Diameter: 9.77 inches.
- B. Clamping Ring:

1. Material: Cast aluminum.
2. Gravel Stop Height: 1.2 inches.
3. Drainage Slots: 18 V-shaped.
4. Bosses: 6, to accept studs on flange.

C. Backflow Seal:

1. Compression Seal: Watertight, "U-Flow" mechanical seal.
2. Material: Polyamide and EPDM rubber.
3. Required for Activation: "U-Flow" screwdriver.

D. Hardware:

1. Locknuts: 6, stainless steel, for studs.
2. Screws: 3, stainless steel, to attach strainer to clamping ring.

E. Overflows:

1. At overflow locations; provide overflow collar extension
2. Constructed of spun aluminum

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.
- B. Coordinate with roofing operation for watertight integrity.
- C. Finished installation shall be water and air tight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION

SECTION 07 22 33 - ROOF SCUTTLE (HATCHES) AND HEAT / SMOKE VENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- A. Section 05 31 00 - Metal Deck
- B. Section 05 50 00 - Miscellaneous Metals
- C. Section 06 10 00 - Rough Carpentry
- D. Section 07 52 19 – Modified Bitumen Membrane Roofing System

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a watertight installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Include materials, opening sizes, fabrication details, hardware, attachments, related and adjacent work, and finishes.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Miami-Dade County, FL Approved NOA
 - a. TAS 201 Impact test
 - b. TAS 202 Uniform Static Air Pressure
 - c. TAS 203 Cyclic Wind Pressure Loading
 - 2. OSHA 29 CFR 1910.23 Guarding floor and wall openings and holes
 - 3. OSHA 29 CFR 1926.502 Fall protection systems criteria
 - 4. International Building Code (IBC) Section 1013.6 Roof Access
 - 5. International Building Code (IBC) Section 1009.11 Means of Egress, Stairways, Stairway to Roof
 - 6. International Building Code for venting requirements
 - 7. IBC Section 410 for Stages and Platforms
 - 8. IBC Section 910 for Factory and Storage occupancies
 - 9. IBC Section 1207 Sound Transmission
 - 10. Underwriters Laboratories Inc, UL 793 Listed for Heat and Smoke Vents
 - 11. FM Global, Factory Mutual, FM 4430 Heat and Smoke Vents for Roofs

12. Reference NFPA 204 for general maintenance of Heat and Smoke vents
13. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site ready use.
- B. Exercise proper care in handling of Work so as not to disrupt finished surfaces.
- C. Store materials under cover in a dry and clean location off the ground.

1.7 WARRANTY

- A. Warrant the work specified herein for five (5) years, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 1. Faulty, improper or inadequate attachment or installation.
 2. Difficult or noisy operation.
 3. Noticeable deterioration of finish.
 4. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements: The Bilco Company.
- B. Manufacturers listed below whose products are equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 1. SafePro products
 2. Acudor Products Inc.
 3. Babcock-Davis Hatchways, Inc.
 4. Dur-Red Products
 5. J. L. Industries, Inc.
 6. Karp Associates, Inc.
 7. Nystrom Building Products

2.2 ROOF SCUTTLES (HATCHES)

- A. Size: Field verify existing and match, unless shown otherwise.
- B. Finish: Mill Finish Aluminum

- C. Thermally Broken Cover: Shall be 11 gauge aluminum with 3" concealed polyisocyanurate insulation, 5" beaded, overlapping flange, fully welded at corners, and internally reinforced for 40 psf live load., fully covered and protected by an aluminum liner. No water standing on top of the cover will be permitted.
- D. Thermally Broken Curb: Shall be 12 inches in height above finished roof surface and constructed of 11 gauge aluminum. It shall be formed with a 5-1/2 inch flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, full welded at the corners for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiber board three (3) inches in thickness.
- E. Thermally Broken Scuttle (Hatch): Shall be completely assembled with heavy pintle hinges, positive snap latch with turn handles, padlock hasps inside and outside, and a mechanically retained thermoplastic rubber gasket. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. Cover shall be equipped with an automatic hold-open arm complete with red vinyl grip handle to permit easy release and one-hand control of the cover to its closed and latched position. All hardware shall be stainless steel. Gasket shall be extruded EPDM adhesive back seal and continuous around cover.
- F. Approved Model / Manufacturer: Type No. "S-50TB" Roof Scuttles (Hatches) for ladder access, or Architect approved equal.
- G. Roof Access Ladder: As specified in Section 05 50 00, Miscellaneous Metals. Ladder shall be oriented and mounted along the short dimension of the hatch.
- H. Telescoping Ladder Safety Post: Model ER-1 Extend-A-Rail Ladders Safety Post as manufactured by Precision Ladders LLC. 1.62" OD Schedule 40 anodized aluminum pipe post and 16"x4"x1/4" aluminum mounting plate. Provide with locking slot and knob. All mounting hardware shall be Type 316 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate installation of sealant and roofing cement with Work of this Section to ensure water tightness.
- B. Coordinate installation of components of this Section with installation of roof deck, roof structure, roofing membrane, and base flashing.
- C. Roof hatches and heat / smoke vents shall be welded to structural steel frame of building.
- D. Install hatches and heat / smoke vents in accordance with details on drawings, approved shop drawings, and manufacturer's instructions.
- E. Set units plumb, level, and true to line without warp or rack. Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

- F. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a watertight and airtight seal.

3.2 FIELD QUALITY CONTROL

- A. Pull internal and / or external manual pull handles and then close vents from the exterior at the roof top level.
- B. Do not paint the internal mechanisms, especially moving parts such as spring, dampers, rotary latches and especially the fusible links. Painting any of these components may damage the vents and will void the warranty.

3.3 ADJUSTING

- A. Adjust movable parts for smooth operation.
- B. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation

3.4 CLEANING

- A. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07 72 33

SECTION 07 81 16 - CEMENTITIOUS FIREPROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sprayed fire-resistive materials.
 - 2. Accessories necessary for a complete installation.
- B. Related Sections:

1.3 REFERENCE STANDARDS

- A. 40 CFR 763 - Asbestos-Containing Materials in Schools; Current.
- B. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- C. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; 2009 Edition, March 1, 2009
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- F. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.
- G. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).
- H. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- I. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).
- J. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).
- K. ASTM E761/E761M - Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).
- L. ASTM E859/E859M - Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural Members; 2023.
- M. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2023).
- N. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- O. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.4 DEFINITIONS

- A. SFRM: Sprayed fire-resistive materials.

1.5 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Fire Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Consider steel members unrestrained unless specifically noted otherwise.
- C. Asbestos: Provide products containing no detectable asbestos.

1.6 SUBMITTALS

- A. Product Data: Technical data, installation instructions, and UL listing for each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
 - 1. Extent of fireproofing for each construction and fire resistance rating.
 - 2. Applicable fire resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thickness necessary to achieve required fire resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.
- C. Samples: Submit for each exposed product and for each color and texture specified, 4 inches (102 mm) square in size.
- D. Product Certificates and Reports:
 - 1. Certificates: Submit manufacturer's precut certificates for each type of SFRM.
 - 2. Evaluation Reports: Submit ICC-ES evaluation report.
 - 3. Compatibility and Adhesion Test Reports: From SFRM manufacturer indicating:
 - a. Materials have been tested for bond with substrates.
 - b. Materials have been verified by SFRM manufacturer to be compatible with substrate primers and coatings.
 - c. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 - 4. Preconstruction test reports.
 - 5. Field quality control reports.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
- B. Installer Qualifications: A firm or individual having minimum 5 years documented experience who is certified or licensed and qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- C. Source Limitations: Obtain fireproofing for each fire resistance design from single source.
- D. Pre-Construction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
 - 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E736/E736M. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 - 2. Density: Test for density according to ASTM E605/E605M. Provide density indicated in referenced fire-resistance design, but not less than minimum specified.
 - 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.

4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.
- E. Pre-Installation Conference: Conduct conference at site.
1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, shelf life, and fire resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, and aboveground; keep dry until ready for use. Remove from site and discard wet or deteriorated materials.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 degrees F (7 degrees C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

1.10 COORDINATION

- A. Sequence and coordinate application of sprayed fireproofing with related work to comply with requirements:
 1. Provide temporary enclosure as required to confine spraying operations and protect the environment.
 2. Provide temporary enclosures for applications to prevent deterioration of fire resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
 3. Avoid unnecessary exposure of fire resistive material to abrasion and damage likely to occur during construction operations subsequent to its application.
 4. Do not apply fire resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire resistive material.
 5. Do not apply fire resistive material to metal floor deck substrates until concrete topping has been completed.
 6. Do not begin applying fire resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 7. Defer installing ducts, piping, and other items that would interfere with applying fire resistive material until application of fire protection is completed.
 8. Do not install enclosing or concealing construction until after fire resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.11 WARRANTY

- A. Written warranty signed by manufacturer, installer, and Contractor in which manufacturer agree to repair or replace fireproofing materials that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and the Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire response testing, and other causes not reasonably foreseeable under conditions of normal use.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Carboline Company; a subsidiary of RPM International: www.carboline.com.
 - 2. GCP Applied Technologies: gcpat.com.
 - 3. Isolotek International: www.isolotek.com.
 - 4. Southwest Fireproofing Products Co.: www.carboline.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 DESCRIPTION

- A. Regulatory Requirements:
 - 1. Building Code:
 - a. Comply with applicable requirements of International Building Code ICC (IBC).
 - 2. Fire Code:
 - a. International Fire Code ICC (IFC) (IFC).
 - 3. Fire Resistance Design:
 - a. Fire Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency. Steel members are to be considered unrestrained unless specifically noted otherwise.
 - 4. Hazardous Materials:
 - a. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, Polarized Light Microscopy.
 - 5. Surface Burning Characteristics:
 - a. Surface Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame Spread Index: 10 or less.
 - 2) Smoke Developed Index: 10 or less.

2.3 MATERIALS

- A. Sprayed Fire-Resistive Material: Factory-mixed, lightweight, dry-formulation, complying with indicated fire resistance design, and mixed with water at site to form a slurry or mortar before conveyance and application.

1. Application: Designated for exterior use by qualified testing agency acceptable to authorities having jurisdiction.
 2. Bond Strength: Minimum 150 lbf/sq.ft. (7.18 kPa) cohesive and adhesive strength based on field testing according to ASTM E736/E736M.
 3. Density: Not less than density specified in the approved fire resistance design, according to ASTM E605/E605M.
 4. Thickness: As necessary required for fire resistance design indicated, measured according to requirements of fire resistance design or ASTM E605/E605M, whichever is thicker, but not less than 3/8 inch (9 mm).
 5. Combustion Characteristics: ASTM E136 .
 6. Compressive Strength: Minimum 10 lbf/sq.ft. (68.9 kPa) according to ASTM E761/E761M.
 7. Corrosion Resistance: No evidence of corrosion according to ASTM E937/E937M.
 8. Deflection: No cracking, spalling, or delamination according to ASTM E759/E759M.
 9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E760/E760M.
 10. Air Erosion: Maximum weight loss of 0.387 gr/sq.ft. (0.270 g/sq.m) in 24 hours according to ASTM E859/E859M .
 11. Fungal Resistance: Treat products with antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 according to ASTM D3274 ASTM D 3274 when tested according to ASTM D3273.
 12. Finish: Spray textured finish unless otherwise indicated.
- B. Auxiliary Materials: Provide auxiliary materials compatible with fireproofing and substrates and approved by UL for use in fire resistance designs indicated.
1. Substrate Primers: Primers approved by fireproofing manufacturer and complying with requirements:
 - a. Primer and substrate are identical to those tested in required fire-resistance design by UL.
 - b. Primer bond strength in required fire resistance design complies with specified bond strength for fireproofing and with requirements in UL Fire Resistance Directory, based on a series of bond tests according to ASTM E736/E736M.
 2. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL Fire Resistance Directory.
 3. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire resistance designs indicated and fireproofing manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
 4. Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with fire resistance designs indicated; approved and provided by fireproofing manufacturer.
 5. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for substrates and conditions affecting performance of the work and according to each fire resistance design.
1. Verify substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.

2. Verify objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 3. Verify substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
 4. Verify concrete work on steel deck is complete before beginning fireproofing work.
 5. Verify roof construction, installation of rooftop HVAC equipment, and related work are complete before beginning fireproofing work.
 6. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
 7. Prepare written report listing conditions detrimental to performance of the work.
 8. Proceed with installation after correcting unsatisfactory conditions.
- B. Conduct tests according to fireproofing manufacturer's written recommendations to verify substrates are free of substances capable of interfering with bond.
- C. Prepare written report listing conditions detrimental to performance of the work.
- D. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Cover adjacent work subject to damage from fallout or overspray of fireproofing materials during application. Clean substrates of substances that could impair bond of fireproofing.
- B. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- C. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
 2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

- F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
 - 1. For applications over encapsulant materials, including lockdown (post removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
 - 2. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
 - 1. Cure fireproofing according to fireproofing manufacturer's written instructions.
- I. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- J. Cure fireproofing according to fireproofing manufacturer's written instructions.
- K. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
 - 2. Spray Textured Finish: Finish left as spray applied with no further treatment.
 - 3. Rolled, Spray Textured Finish: Even finish produced by rolling spray applied finish with a damp paint roller to remove drippings and excessive roughness.
 - 4. Skip Troweled Finish: Even leveled surface produced by troweling spray applied finish to smooth out the texture and neaten edges.
 - 5. Skip Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: The Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the applicable Building Code and indicated in Schedule of Special Inspections.
- B. Perform the tests and inspections of completed work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel applied product.

END OF SECTION 07 81 16

SECTION 07 81 23 - INTUMESCENT FIREPROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Mastic and intumescent fire resistive coatings.
 - 2. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- D. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire resistance design and manufacturer's written instructions.
- B. Fire Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- C. Surface Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Spread Index: 25 or less.
 - 2. Smoke Developed Index: 450 or less.
- D. Asbestos: Provide products containing no detectable asbestos.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
 - 1. Extent of fireproofing for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.
- D. Qualification Data: For Installer and testing agency.
- E. Product Certificates: For each type of fireproofing.
- F. Evaluation Reports: For fireproofing, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of each type of fireproofing and different substrate and each required finish.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Pre-Installation Conference: Conduct conference at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 degrees F (10 degrees C)] or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 PRODUCTS

2.1 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

- A. Interior Mastic and Intumescent Fire Resistive Coating: Factory mixed formulation consisting of intumescent base coat and topcoat (if required), and complying with indicated fire resistance design.
 - 1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. Albi Manufacturing; a division of StanChem, Inc.
 - b. Carboline Company; a subsidiary of RPM International.
 - c. Isolatek International.
 - 2. Basis of Design: "CAFCO SprayFilm WB 5 System" as manufactured by Isolatek International
 - 3. Interior Application: Designated for "interior general purpose" "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
 - 4. Thickness: Required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
 - 5. Hardness: Not less than 65 Type D durometer, according to ASTM D2240.
 - 6. Finish: As selected by Architect from manufacturer's standard finishes or spray-textured finish.
 - a. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

- B. Exterior Mastic and Intumescent Fire Resistive Coating: Factory mixed formulation consisting of intumescent base coat and topcoat, and complying with indicated fire resistance design.
 - 1. Manufacturers: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. Albi Manufacturing; a division of StanChem, Inc.
 - b. Carboline Company; a subsidiary of RPM International.
 - c. Isolatek International.
 - 2. Basis of Design: "CAFCO SprayFilm WB 4 System" as manufactured by Isolatek International
 - 3. Exterior Application: Designated for "exterior" use by a qualified testing agency acceptable to authorities having jurisdiction.
 - 4. Thickness: Required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
 - 5. Hardness: Not less than 65 Type D durometer, according to ASTM D2240.
 - 6. Finish: As selected by Architect from manufacturer's standard finishes or spray-textured finish.
 - a. Color and Gloss: As indicated by manufacturer's designations, match Architect's sample or as selected by Architect from manufacturer's full range.

2.2 AUXILIARY MATERIALS

- A. Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
- E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.
 - 1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulate, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 - 2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

- B. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- E. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- F. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- I. Cure fireproofing according to fireproofing manufacturer's written instructions.
- J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- K. Finishes: Where indicated, apply fireproofing to produce the following finish.

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Test and inspect as required by the IBC.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to Work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 07 81 23

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SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
- D. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- E. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

1.4 ALLOWANCES

- A. Penetration firestopping Work is part of an allowance.

1.5 UNIT PRICES

- A. Work of this Section is affected by unit prices.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.8 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to GlobalFM 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.11 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

1.12 WARRANTY

- A. Written warranty signed by manufacturer, installer, and Contractor in which manufacturer agree to repair or replace firestopping materials that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.

2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 1. Permanent forming/damming/backing materials.
 2. Substrate primers.
 3. Collars.
 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer

speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 13

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SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
 - 3. Joints in smoke barriers.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
- E. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global's FM 4991, "Standard for the Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E2307.
 - 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 43

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Control and expansion joints on exposed interior surfaces.
 - 2. Perimeter joints between interior wall surfaces and frames of interior doors and openings.
 - 3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 4. Joints indicated or as necessary.
 - 5. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.
 - 1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.
 - a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.
 - b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
 - c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.
 - 2. Recycled Content:
 - a. Indicate recycled content; indicate percentage of preconsumer and postconsumer recycled content per unit of product.
 - b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
 - d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.
 - 3. Local/Regional Materials:
 - a. Sourcing location(s): Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.
 - b. Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
 - c. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
 - d. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

4. VOC Data: Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
5. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.

B. Certificates and Reports:

1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
 - b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
6. Field Adhesion Test Reports: For each sealant application tested.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
 2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.
- B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 2. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.
- D. Environmental Requirements:
1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
 - a. VOC Content of Interior Sealants: Sealants and sealant primers complying with limits for VOC content for SCAQMD when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1) Sealants: 250 g/L.
 - 2) Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3) Sealant Primers for Porous Substrates: 775 g/L.
 - b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
 - 2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 WARRANTY

- A. Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance, weather resistance, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.
- C. Warranties specified exclude deterioration or failure of sealants from:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.

- B. Liquid Applied Sealants: Comply with ASTM C 920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide nonstaining products that have undergone testing according to ASTM C 1248 and do not stain porous joint substrates.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent surface.
- F. Manufacturer's Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer's materials.
- G. Sealants: Self leveling compounds for horizontal joints in pavements and nonsag compounds elsewhere except as shown or specified.
- H. Silicone Sealant:
 - 1. Use: Wetglazing (Single component sealants).
 - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.
 - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
 - 4. Product and Manufacturer:
 - a. Dow Corning Corporation; 795, 999 as applicable.
- I. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
 - 1. Use: Typical Wall Joints (one part polyurethane sealants).
 - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates.
 - 3. Products and Manufacturers:
 - a. BASF Building Systems; Sonolastic NP-1.
 - b. Pecora Corporation; Dynatred.
 - c. Sika Corporation, Construction Products Division; Sikaflex 2c NS or Sikaflex 2c NS TG as applicable.
- J. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
 - 1. Use: Typical Wall Joints (Two Part Polyurethane Sealants).
 - 2. Properties: Performance: Nonstain, nonbleed, nonstreaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.
 - 3. Products and Manufacturers: One of the following:
 - a. Schnee-Morehead, Inc.; Permathane SM 7200.
 - b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
 - c. BASF Construction Chemicals; NP 2.
- K. Sealant Backing: Provide sealant backings that are nonstaining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Cylindrical Sealant Backings: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type

- indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
2. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state; one of the following:
 - a. HBR Closed Cell Backer Rod; Nomaco, Inc.
 - b. Sonolastic Closed-Cell Backer-Rod; BASF Construction Chemicals.
 - L. Weep and Vent Tubes: Clear plastic (PVC) tubing, minimum 1/4 inch (6.35 mm) inside diameter, and length required to extend between exterior face of sealant and open cavity behind. At window and curtain wall systems, where required by system designer, provide gutter termination of tube with preformed nipples suitable for sealing to gutter.
 - M. Miscellaneous Materials:
 1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
 2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
 3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
 4. Cork Joint Filler: Resilient and nonextruding, ASTM D1752, Type II.
 5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self adhesive tape where applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:
 1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
 2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.
 3. Remove laitance and form-release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming (Elastomeric Sealants Only): Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint

sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. Silicone Glazing Sealants: Refer to Section 08 80 00.
- B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- C. Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants applicable to materials, applications, and conditions indicated.
- D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
 - 4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.
- E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.
- F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
 - 1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
 - 2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
 - 3. Apply nonelastomeric sealants to a depth approximately equal to the joint width.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
 - 1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 - 2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
 - 3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.
- H. Installation of Preformed Silicone Sealant System:
 - 1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.

2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
 3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
- I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- J. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer written recommendations.

3.4 FIELD QUALITY CONTROL

- A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
1. Extent of Testing: Test completed and cured sealant joints:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.
 4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.
- B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 SITE ENVIRONMENTAL PROCEDURES

- A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

3.6 CLEANING AND PROTECTION

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 07 92 00

SECTION 07 95 13 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Expansion joint cover assemblies for floor, wall, ceiling, and soffit surfaces.
- B. Related Sections:
 - 1. Section 04 05 00 - Common Work Results for Masonry: Placement of joint cover assembly frames in masonry.
 - 2. Section 05 50 00 - Metal Fabrications: Custom fabricated metal expansion and control joint devices.

1.3 REFERENCE STANDARDS

- A. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- B. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- D. Samples: Submit two samples 6 inches long, illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Architectural Art Mfg, Inc: www.archart.com.
 - 2. Balco, Inc.: www.balcousa.com.
 - 3. Construction Specialties, Inc: www.c-sgroup.com.
 - 4. EMSEAL Joint Systems, Ltd: www.emseal.com.
 - 5. Inpro: www.inprocorp.com.
 - 6. MM Systems Corp: www.mmsystemscorp.com.
 - 7. Nystrom, Inc: www.nystrom.com.
 - 8. Pecora Corporation: www.pecora.com.
 - 9. SITURA Inc: www.situra.com.
 - 10. Watson Bowman Acme Corporation: www.watsonbowmanacme.com.

- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior Floor Joints Subject to Thermal Movement (EJC-1):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Balco, Inc; No-Bump Floor to Floor System, Aluminum (NBAF).
 - b. Construction Specialties, Inc; Allway Standard Metal Floor Covers.
 - c. Watson Bowman Acme Corporation; Wabo CorridorWrap Floor.
- B. Interior Floor Joints Subject to Seismic Movement (EJC-2):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Construction Specialties, Inc; Allway Seismic Metal Floor Covers.
 - b. Watson Bowman Acme Corporation; Wabo Allure.
- C. Interior Wall/Ceiling Joints Subject to Thermal Movement (EJC-3):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Balco, Inc; Wall and Ceiling Snap-On Joint Cover (WD).
 - b. Construction Specialties, Inc; Allway Standard Wall and Ceiling Covers.
- D. Interior Non-Fire-Rated Wall/Ceiling Joints Subject to Seismic Movement (EJC-4):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Construction Specialties, Inc; Flush Seismic Wall and Ceiling Covers.
- E. Interior Fire-Rated Floor/Wall Joints Subject to Seismic Movement (EJC-6):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Watson Bowman Acme Corporation; Wabo FlameGuard II.
- F. Interior Fire-Rated Floor/Wall/Ceiling Joints Subject to Thermal Movement (EJC-7):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Construction Specialties, Inc; Fire Barriers.
- G. Interior/Exterior Fire-Rated Wall Joints Subject to Thermal Movement (EJC-8):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. EMSEAL Joint Systems, Ltd; Emshield WFR2 System.
- H. Exterior Wall Joints Subject to Thermal Movement (EJC-9):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Balco, Inc; Exterior Wall, Elastomeric Face Seal System (FCWW).
 - b. Construction Specialties, Inc; Exterior Wall Covers.
 - c. EMSEAL Joint Systems, Ltd; BG System.
 - d. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.
- I. Exterior Wall Joints Subject to Seismic Movement (EJC-10):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.
- J. Exterior Roof Bellows with Metal Flange Expansion Joint Covers (EJC-11):
 - 1. Basis of Design Manufacturer(s) and Product(s):
- K. Exterior Roof Expansion Joint Covers (EJC-12):
 - 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Balco, Inc; Roof Metal Plate System, with Canted Curb (LPR).
 - b. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.

2.3 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 - 4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
 - 1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
 - 2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
- C. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
- D. Covers in Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

2.4 MATERIALS

- A. Anchors and Fasteners: As recommended by cover manufacturer.
- B. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
- C. Threaded Fasteners: Aluminum.
- D. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

2.5 ACCESSORIES

- A. Resilient Fire Barrier: For use with metal expansion joint covers and elastomeric seals without use of mechanical fasteners, with fire rating in accordance with surrounding construction performance capabilities.
 - 1. Application: Floor.
 - 2. Fire Resistance Rating: 2-hour, in accordance with ASTM E1966 and UL 2079.
 - 3. Joint Opening: 3/8 inch (9.5 mm), nominal.
 - 4. Manufacturer(s) and product(s):
 - a. Balco, Inc; Expansion Joint Fire Barrier, Floor/Roof - MetaBlock, 2 Hour (MBF2H).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.2 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Install expansion joints in accordance with TCA publication EJ171.
- C. Align work plumb and level, flush with adjacent surfaces.
- D. Rigidly anchor to substrate to prevent misalignment.

3.3 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION 07 95 13

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide items shown on the Drawings and specified, including, but not limited to the following:
 - 1. Standard steel doors for interior or exterior use.
 - 2. Acoustically-insulated steel doors for interior use.
 - 3. Opening protective steel doors for interior or exterior use.
 - 4. Thermally-insulated doors for interior or exterior use.
 - 5. Steel frames for doors, sidelites, transoms, and windows.
 - 6. Louvers in steel doors.
 - 7. Vision lites in steel doors.
 - 8. Sound rated steel doors.
 - 9. Thermally rated steel doors.
- B. Related Sections:
 - 1. Section 05 40 00 - Cold Formed Metal Framing.
 - 2. Section 07 92 00 - Joint Sealants.
 - 3. Section 08 80 00 - Glazing.
 - 4. Section 09 21 16 - Gypsum Board Assemblies.
 - 5. Section 09 24 00 - Cement Plastering.
 - 6. Section 09 90 00 - Painting and Coating.

1.3 REFERENCE STANDARDS

- A. ANSI A250.13 - Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies for Protection of Building Envelopes; 2018.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- E. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.
- F. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- H. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- J. {RSTEMP#1253}
- K. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- L. AWS D1.6/D1.6M - Structural Welding Code— Stainless Steel; Current.

- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- O. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:
 - 1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the contract Drawings. If any door is not by the steel door manufacturer, only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.):
 - a. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.
- C. Samples are required from non-Steel Door Institute members:
 - 1. 12 inch by 12 inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
 - 2. 12 inch by 12 inch sample of each type of door louver specified or required, showing louver construction.
 - 3. 6 inch long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.
- D. Certificates: Manufacturer's certification that oversized openings are in compliance with specifications.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of 5 years' experience.
- B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer's insignia, which is being supplied.
- C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.
- D. Windstorm Resistance: Comply with ANSI A250.13.
- E. Structural Performance: Comply with ASTM E330/E330M.
- F. Air Leakage: Comply with ASTM E283/E283M.
- G. Regulatory Requirements:
 - 1. Fire-Rated Assemblies:
 - a. Opening protective door, panel, frame, and fire window construction shall conform to NFPA 252, or UL 10B, as applicable, and acceptable to the code of authorities having jurisdiction.
 - b. Opening Protective Door Construction:
 - 1) Notwithstanding any other requirements of this Section, provide gauge of metal, method of construction, hardware preparation, reinforcement, and placement, glass opening size, and other specifics required to obtain the specified or required label. The label shall contain the fire resistance rating (20 minute, 45 minute, 1 hour, 1-1/2 hour, 3 hour, etc.) and the designation (A, B, C, D, or E); doors with B Label being 1-1/2 hour.
 - 2) Fire-rated doors used in a stairway enclosure, shall be so constructed so that the maximum transmitted temperature shall not exceed 450 degrees F above

ambient temperature at the end of 30 minutes of the Standard Fire Exposure Test and shall be so noted on the label.

c. Opening Protectives Hollow Metal Doors:

- 1) Conform to NFPA 80 for fire-rated class shown or required by code of authorities having jurisdiction:
 - (a) Units shall be identical to assemblies whose fire resistance characteristics have been determined in accordance with requirements specified above, and shall be labeled and listed by UL, WHI, or other inspection and testing agency acceptable to the code of authorities having jurisdiction.
 - (b) Fire-rated steel doors, panels, frames, and fire windows shall bear permanent labels attesting to fire resistance. At stairway enclosures, provide units listed for 450 degree F maximum temperature rise rating for 30 minutes of exposure.
 - (c) Oversized openings shall be constructed in accordance with all applicable requirements for labeled door construction.
 - (d) Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80.
 - (e) Locate label on hinge side of doors and frames so that when door is closed, label is not visible.
 - (f) Caution shall be taken to ensure that labels are not removed, damaged, or painted over.
 - (g) Glass panes shall not exceed sizes allowed whether indicated or not on the Drawings.

2. Wind Loads:

- a. Provide hollow metal and door hardware assemblies approved by Authorities Having Jurisdiction (AHJ), including anchorage, capable of withstanding wind load design pressures calculated for this Project by a registered Engineer and are part of the construction documents.

H. Pre-Installation Conference: Refer to Section 01 31 00 - Project Management and Coordination.

1.6 WARRANTY

- A. Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 1. Use of incorrect materials in opening.
 2. Incorrect labeled components installed within opening.
 3. Noisy, rough, or difficult operation.
 4. Failure to meet specified quality assurance requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in accordance with manufacturer's instructions, and as follows:
 1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
 2. Containers or wrappers shall list the name of the manufacturer and product.
- B. Deliver materials to allow for minimum storage time at the Project site. Coordinate delivery with the scheduled time of installation.
- C. Protect products from moisture, construction traffic, and damage:
 1. Store under cover in a clean, dry place, protected from weather and abuse.
 2. Store in a manner that will prevent rust or damage.
 3. Store doors in a vertical position, spaced with blocking to permit air circulation.
 4. Do not use non-vented plastic or canvas shelters.

5. Should containers or wrappers become wet, remove immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Ceco Door, an ASSA ABLOY company: www.cecodoor.com
 2. CURRIES, an ASSA ABLOY company: www.curries.com
 3. Pioneer Industries, Inc., an ASSA ABLOY company: www.pioneerindustries.com
 4. Republic Builders Products Company: www.republicdoor.com
 5. Steelcraft Mfg. Co., an Allegion company: www.steelcraft.com
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DESCRIPTION

- A. Regulatory Requirements:
 1. Americans with Disabilities Act of 1990, as amended:
 - a. ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
 2. Welding Qualifications: Qualify procedures and personnel according to the following:
 - a. Aluminum: {RS#1253}.
 - b. Sheet Steel: AWS D1.3/D1.3M.
 - c. Stainless Steel: AWS D1.6/D1.6M.
 - d. Steel: AWS D1.1/D1.1M.

2.3 MATERIALS, GENERAL

- A. Exterior frames and interior frames where shown on Drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvanized to A60 minimum coating weight standard per ASTM A653/A653M and ASTM A924/A924M, with coating weight of not less than 0.60 ounce per square foot (183 grams per square meter).

2.4 FRAME FABRICATION

- A. Minimum Gauges:
 1. Interior:
 - a. Openings less than 4 feet wide: 16 gauge.
 - b. Openings 4 feet in width and greater: 14 gauge.
 2. Exterior: 14 gauge.
- B. Design and Construction:
 1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90 degree walls shall have at least 4 inch (102 mm) wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4 inch (121 mm) at 4 inch (102 mm) CMU, 6-3/4 inch (171 mm) at 6 inch (152 mm) CMU, and 8-3/4 inch (222 mm) at 8 inch (203 mm) CMU. At masonry wall openings, fabricate frames to suite masonry opening with 2 inch (51 mm) head member.
 2. Frames shall be strong and rigid, neat in appearance, square, true, and free of defects, warp, and buckle. Molded members shall be clean cut, straight, and of uniform profile throughout their length.
 3. Jamb depths, trim, profile, and backbends shall be as shown on approved shop drawings.

4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames are not permitted.
5. Minimum depth of stops shall be 5/8 inch (16 mm), except at fire windows where minimum depth of stops shall be 3/4 inch (19 mm).
6. Frames for multiple openings shall have mullion and rail members that are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to the Owner's key system.
7. High-Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48 inches (1,219 mm) and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
8. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.
9. Provide countersunk flat or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
10. Provide A60 galvanized coating at frames in the following locations:
 - a. Restrooms.
 - b. Kitchens / kitchen suites.
11. Electrical Knock Out Boxes:
 - a. Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic locks as noted in door hardware sets in Section 08 71 00 - Door Hardware:
 - 1) Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations.
 - 2) Provide electrical knock out boxes with 3/4 inch knockouts.
 - 3) Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
 - 4) Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Section 08 71 00 - Door Hardware.
 - 5) Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
 - 6) Provide field installed conduit per Division 28 - Electronic Safety & Security Section for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Section 08 71 00 - Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
12. Hardware reinforcements:
 - a. Frames shall be mortised, reinforced, drilled, and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
 - b. Minimum thickness of hardware reinforcing plates shall be as follows:
 - 1) Hinge and pivot reinforcements (1-1/4 inch (32 mm) by 10 inch (254 mm) minimum size): 7 gauge.
 - 2) Strike Reinforcements: 12 gauge stiffeners.
 - 3) Flush Bolt Reinforcements: 12 gauge.

- 4) Closer Reinforcements: 12 gauge.
 - 5) Reinforcements for surface-mounted hardware, hold-open arms, and surface panic devices: 12 gauge.
 13. Floor Anchors: Minimum 14 gauge, securely welded inside each jamb, with holes for floor anchorage.
 14. Jamb Anchors:
 - a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-strap type. Anchors shall be not less than 16 gauge steel. The number of anchors provided at each jamb shall be as follows:
 - 1) Frames up to 7 feet 6 inches (2,286 mm) in height: Three anchors.
 - 2) Frames 7 feet 6 inches (2,286 mm) to 8 feet (2,438 mm) in height: Four anchors.
 - 3) Frames over 8 feet (2,438 mm) in height: One anchor for each 2 feet (610 mm) or fraction thereof in height.
 - b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16 gauge thickness, securely welded inside each jamb as follows:
 - 1) Frames up to 7 feet 6 inches (2,286 mm) in height: Four anchors.
 - 2) Frames 7 feet 6 inches (2,286 mm) to 8 feet (2,438 mm) height: Five anchors.
 - 3) Frames over 8 feet (2,438 mm) in height: Four anchors plus one additional for each 2 feet (610 mm) or fraction thereof over 8 feet (2,438 mm).
 - c. Frames to be anchored to previously placed concrete, masonry, or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
 15. Dust Cover Boxes: Shall be of not less than 26 gauge steel and shall be provided at all mortised hardware items. 8 inch (203 mm) CMU walls with face brick shall have dual offset jamb anchors.
 16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
 17. Loose glazing stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
 18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch (1.6 mm).
- C. Frame Color: Field paint under Section 09 90 00 - Painting and Coating, color as indicated on Drawings.

2.5 DOOR FABRICATION

- A. Minimum Gauges:
 1. Doors: 0.047 inch (1.2 mm) or 18 gauge (16 gauge for high frequency doors).
 2. 16 gauge (14 gauge for windstorm rated doors).
- B. Design and Construction:
 1. Thickness shall be 1-3/4 inches (44 mm), unless specifically noted or shown otherwise.
 2. Exterior doors: Provide doors with 22 gauge steel z-channels placed at 6 inches (152 mm) apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
 3. Fabrication:
 - a. Doors shall be strong, rigid, and neat in appearance, free from warpage and buckle.
 - b. Corner bends shall be true, straight, and of minimum radius for gage of metal used.
 - c. Provide stiffeners with polystyrene core spaced maximum 6 inches on center and extending full height of door.
 - d. Fill interior with noncombustible fiberglass insulation. Use rock mineral wool board filler as required for labeled doors.

- e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled, and dressed smooth to provide a smooth flush surface.
- f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
- g. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Section 08 71 00 - Door Hardware.
- h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Section 08 71 00 - Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
- i. Doors in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
- j. Edge profile shall be provided on both vertical edges of door as follows:
 - 1) Single-acting swing doors: Beveled 1/8 inch (3 mm) in 2 inches (51 mm) .
- k. Hardware Reinforcements:
 - 1) Doors shall be mortised, reinforced, drilled, and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
 - 2) Minimum gauges for hardware reinforcing plates shall be as follows:
 - (a) Hinge and pivot reinforcements: 7 gauge.
 - (b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
- 4. Glass Moldings and Stops: Loose stops shall be not less than 20 gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
- 5. Louvers: Shall be inverted "V" blade, sight-proof type, unless noted otherwise.
- 6. Edge Clearances:
 - a. Between door and frame at head and jambs: 1/8 inch (3 mm).
 - b. At doorsills with no threshold: 5/8 to 3/4 inch (16 to 19 mm) above finished floor.
 - c. At doorsills with threshold: As required to suit threshold.
 - d. Between meeting edges of double doors: 1/8 inch (3 mm).
- C. Finish:
 - 1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
 - a. Clean surfaces free of mill scale, rust, oil, grease, dirt, and other foreign matter.
 - b. Chemically treat surfaces and apply 1 coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil (0.0127 mm) dry film thickness.
 - 2. Field painted under Section 09 90 00 - Painting and Coating.
- D. Sound Rated Door: STC as indicated in Door Schedule, measured in accordance with ASTM E413.
- E. Thermal Insulated Door: Total insulation R-Value as indicated in Door Schedule, measured in accordance with ASTM C1363, unless otherwise noted on Drawings.

2.6 LABELED DOORS AND FRAMES

- A. Labeled doors and frames shall be provided for openings requiring fire protection ratings as scheduled and to comply with NFPA 80. Such doors and frames shall be constructed as tested

and approved by UL, WHI, or other nationally recognized testing agency having a factory inspection service and approved by code authorities having jurisdiction and shall bear the appropriate permanent label.

- B. If any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its size, design, hardware, or other reason, the Architect shall be so advised before fabrication work on that item is started. Indicate and highlight on shop drawing.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate the work of this Section.
- B. Coordinate hardware installation with opening construction. Door hardware is specified in Section 08 71 00 - Door Hardware.
- C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00 - Glazing.
- D. Coordinate doors and frames with painting specified in Section 09 90 00 - Painting and Coating.

3.2 INSTALLATION

- A. Separate dissimilar metals. Protect against galvanic action.
- B. Frames:
 - 1. Anchorage and connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180 degree door swing.
 - 2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
 - 3. Frame spreader bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
 - 4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled frames.
- C. Doors:
 - 1. Install hardware in accordance with hardware manufacturer's templates and instructions.
 - 2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
 - 3. Adjust operable parts for correct function.
 - 4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled doors.

3.3 ADJUST AND CLEAN

- A. Adjust doors for proper operation, free from binding or other defects.
- B. Clean and restore soiled surfaces.
- C. Remove scraps and debris, and leave site in clean condition.

END OF SECTION 08 11 13

SECTION 08 11 16 - ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior aluminum door and frame systems.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 08 14 16 - Flush Wood Doors.
 - 3. Section 08 80 00 - Glazing.
 - 4. Section 09 21 16 - Gypsum Board Assemblies.

1.3 REFERENCES STANDARDS

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's literature describing products to be provided.
- B. Shop Drawings:
 - 1. Submit shop drawings showing elevation of frames, profile, design construction details, methods of assembling sections, hardware locations, dimensions, anchorage and fastening methods, wall opening construction and finish requirements. Indicate location of each frame in Project.
 - a. Indicate location of each frame in Project.
 - b. Cross reference to Schedules.
- C. Samples:
 - 1. Submit four samples of frames showing selected finishes, corner joint, hinge reinforcement and anchors.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage experienced Installer who has completed installations of aluminum frames similar in design and extent to those required for project and whose work has resulted in construction with record of successful in-service performance.
- B. Manufacturer's Qualifications:
 - 1. Provide aluminum framing systems produced by firm experienced in manufacturing systems that are similar to those indicated for this project and that have record of successful in-service performance.
- C. Single Source Responsibility:
 - 1. Obtain aluminum framing systems from one source and from single manufacturer.
- D. Design Criteria:

1. Drawings indicate the size, profile and dimensional requirements of aluminum frames required and are based on specific types and models indicated.
 2. 60/90 minute rated frames shall be aluminum clad frames. Hollow metal not permitted.
- E. Regulatory Requirements:
1. Installed frame and door assembly shall conform to NFPA 80 for fire rated class indicated.
 2. Where doors are noted with an hourly fire resistance rating, provide door and frame assemblies labeled by Underwriter's Laboratory, or any other testing laboratory approved by the local code authorities, to meet the hourly fire rating noted. Assemblies shall meet applicable building code requirements for positive pressure.
 3. Where an aluminum metal frame is used as a glazed opening in an interior fire rated wall assembly, the frame shall be labeled to match the fire rating required for a door assembly in the fire rated wall, except in a 1 hour fire rated corridor wall assembly, the glazed frame shall be labeled to a 45 minute rating. In a 1 hour fire rated corridor wall assembly, where the door frame is integral with the glazed frame, the frame shall have a 45 minute rating.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials in original unopened packaging with labels intact.
 2. Handle frames in a manner to prevent damage to finishes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Avalon International Aluminum, LLC: www.avalonint.com.
 2. Frameworks. Not desired.
 3. RACO Interiors: www.racointeriors.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 BASIS OF DESIGN

- A. Acoustical Frames: Eagle Series manufactured by Avalon International Aluminum, LLC.
- B. Fire-Resistant-Rated Frames: Phoenix Series manufactured by Avalon International Aluminum, LLC.
- C. Classic Interior OfficeFronts System manufactured by RACO Interiors.
- D. Examslide as manufactured by ADSystems.

2.3 MATERIALS

- A. Aluminum Frames: Extruded aluminum
1. Standard alloys shall conform to requirements published in AA ASD-1 and ASTM B221; 6063 T5 alloy.
 2. Thickness: 0.062 inch minimum.
 3. Finish: Thermal-setting powder coating / Class II clear anodized.
 4. Flush 1-1/2 inch or 2 inch face casing, extended lip strike not permitted.
 5. Throats or frames to be nominal wall thickness plus an 1/8 inch.
- B. Fire Rated Frames:
1. Labeled frames shall be provided for those openings requiring a 20/45/60/90 minute fire protection rating as indicated on Drawings.

2. Frames shall be constructed as tested and approved by Warnock Hersey Laboratories. Other nationally recognized testing agency having a periodical factory inspection service may be used subject to approval of authority having jurisdiction.
 3. Should any frame indicated to be fire rated not qualify for appropriate labeling because of its design, hardware, or any other reason, notify Architect before fabrication work on that frame is started.
- C. Doors: Manufacturer's standard glazed aluminum doors for manual-swing or sliding operation.
1. Door Construction: 1-3/4 inch overall thickness, with extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that incorporate concealed tie bolts.
 2. Door Design: Wide Stile; 5 inch nominal width.
 3. Glazing Stops and Gaskets: Snap-on, extruded aluminum stops and preformed gaskets.
- D. Glass and Glazing Materials: Refer to Section 08 80 00 - Glazing.
- E. Fasteners: Provide fasteners of aluminum, non-magnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be non-corrosive and compatible with aluminum components, hardware, anchors and other components.
1. Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.
 2. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.

2.4 FABRICATION

- A. Frames:
1. Frames shall be knock-down units consisting of separate header, strike and hinge jambs with snap-on casing, fabricated to sizes indicated on Drawings.
 2. Thickness of main frame members shall be increased to 0.130 inch minimum at frame and hinge anchorage.
 3. Frames shall be supplied with a notch at top of jamb and corner brackets to provide for correct alignment with header and add strength to joint.
 4. Stops shall be provided with a continuous nylon backed wool pile sound and light seal around perimeter.
 5. Finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warp, or buckle. Members shall be clean cut, straight and of uniform profile throughout their lengths.
 6. Frames shall be pressure fit type that are installed after partition is in place. Frames shall be anchored at bottom of each jamb. Additional anchors shall be furnished per manufacturer's recommendations.
 7. Glazing frames shall be provided with snap-in type stops with manufacturer's standard neoprene gaskets. Glass installed adjacent to metal without intervening gasket shall not be allowed. Door jambs with integral glazing shall have reinforcement channel. Intermediate mullions shall maintain 1-1/2 inch profile.
 8. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.
 9. Uniformity of Metal Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample per submittal.
 10. Fasteners: Exposed fasteners not permitted.

2.5 FINISHES

- A. Shop Applied Finish:
 - 1. Remove die markings prior to finishing operations. Perform this work in addition to finish specified. Scratches, abrasions, dents and similar defects are not acceptable.
 - 2. Color: Powder coating, color to be selected by Architect.
- B. Thermal-Setting Powder Coatings:
 - 1. Aluminum frames shall have shop applied finish with a thermal-setting powder coating applied in compliance with AAMA 605.2. Finish system shall have a minimum dry film thickness of 1.8 mil applied over a seven stage aluminum pre-treatment.
 - 2. Colors: Manufacturer's standard color or custom color to match control sample provided by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Frames:
 - 1. Prior to installation rough openings shall be checked and corrected for size, squareness, alignment and plumbness.
 - 2. Slip header and jambs into rough opening, allowing header to rest on jambs. Align to scheduled opening width and height, achieving equal wall capture at both jambs.
 - 3. Check level of header and squareness and plumb of jambs. Measure width at each hinge location.
 - 4. Attach flat corner angles at faces of head. Anchor jambs and header in legs of frame at top and bottom of jambs and at approximately 15 inches on center.
 - 5. Install mitered trims by snapping over receiver tabs and lightly tapping with a rubber mallet.
- B. Tolerances:
 - 1. Squareness: + 1/16 inch.
 - a. Measured on a line 90 degree from one jamb, at upper corner of frame at other jamb.
 - 2. Alignment: + 1/16 inch.
 - a. Measured on jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: + 1/16 inch.
 - a. Measured at face corners of jambs on parallel line.
 - 4. Plumbness: + 1/16 inch.
 - a. Measured on the jamb at floor.

3.2 ADJUSTING

- A. Final Adjustments:
 - 1. Check and re-adjust operating finish hardware just prior to final inspection and after painting hinges.
 - 2. Remove and replace defective work.

3.3 CLEANING

- A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.
- B. Clean glass surfaces after installation complying with requirements contained in Section 08 80 00 - Glazing for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.
- C. Door opening assemblies shall be cleaned with general, non-abrasive cleaners suitable for painted surfaces. Wipe the surfaces with a soft, dry cloth per AAMA 609 & 610.

3.4 PROTECTION

- A. Institute protective measures required throughout remainder of construction period to ensure that aluminum frames will be without damage or deterioration, other than normal wear at time of acceptance.

END OF SECTION 08 11 16

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SECTION 08 31 00 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall- and ceiling-mounted access units.
- B. Related Sections
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Placement of access frame unit anchors in concrete.
 - 2. Section 04 20 00 - Unit Masonry: Placement of access frame unit anchors in masonry.
 - 3. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 REFERENCE STANDARDS

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Samples: Submit two access units, 6 by 6 inches (150 by 150 mm) in size indicating frame configuration.
- E. Manufacturer's Installation Instructions: Indicate installation requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Project Record Documents: Record actual locations of each access unit.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Wall and/or Ceiling Access Units:
 - a. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
 - b. ACUDOR Products Inc: www.acudor.com.
 - c. BAUCO Access Panel Solutions Inc.: www.accesspanelsolutions.com.
 - d. Best Access Doors: www.bestaccessdoors.com.
 - e. BILCO Company: www.bilco.com.
 - f. Cendrex, Inc: www.cendrex.com.
 - g. Elmdor: www.elmdor.com.
 - h. FF Systems, Inc: www.ffsystemsinc.com.
 - i. Karp Associates, Inc: www.karpinc.com.

- j. MIFAB, Inc: www.mifab.com.
 - k. Milcor, Inc: www.milcorinc.com.
 - l. Nystrom, Inc: www.nystrom.com.
 - m. Studco Building Systems: www.studcosystems.com.
 - n. Williams Brothers Corporation of America (The): www.wbdoors.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 ACCESS DOOR AND PANEL ASSEMBLIES

- A. General:
- 1. The following access panel types are for selection as required whether or not indicated on Drawings. The Contractor shall evaluate the specific requirements and provide the appropriate system based on the condition, as all types may not be required on the project. The inclusion of any of the listed access panel types does not necessarily imply that the condition exists in the scope of work.
 - 2. Location: As indicated on Drawings or as required to access building systems.

2.3 WALL AND/OR CEILING ACCESS UNITS

- A. Non-Fire-Rated Access Door:
- 1. Basis of Design: Type K or KD, as indicated on Drawings, manufactured by The BILCO Company.
 - 2. Description: General duty access panel designed for use in walls and ceiling.
 - 3. Material: 1/4 inch (6 mm) aluminum cover and extruded aluminum frame.
 - 4. Frame: Extruded aluminum angle frame with strap anchors bolted around perimeter.
 - 5. Cover: Diamond-pattern tread plate reinforced for 150 psf (732 kg/sq. m) live load.
 - 6. Hinges: Concealed, cast-steel, cam-action.
 - 7. Latch: Type 316 stainless steel slam lock with fixed interior handle and removable exterior turn/lift handle.
 - 8. Lift Assistance: Torsion bars that pivot on cam-action hinges with automatic hold-open arm with grip handle release.
 - 9. Finish: Mill.
 - 10. Hardware: Manufacturer's standard.
 - 11. Size: As indicated on Drawings or as required for proper access.
- B. Fire-Rated, Wall-Mounted and Ceiling Mounted Units:
- 1. Basis of Design Product: WB FR 800 Series manufactured by The Williams Bros. Corporation of America.
 - 2. Description: Fire rated access panel designed for use in walls and ceilings where fire resistance is required.
 - 3. Frame: 16 gauge steel frame.
 - 4. Door: 2-1/2 inches deep, 20 gauge steel door.
 - 5. Finish: Primed white baked enamel finish.
 - 6. Hinges: Fully concealed, pivot rod hinge to allow for 140 degree opening.
 - 7. Latching: Self-latching slam catch. Provide spring closer for vertical applications.
 - 8. Mounting: Provide surface-mounted face frame and door surface flush with wall surface.
 - 9. Size: As indicated on Drawings or as required for proper access.
- C. Wall-Mounted Units for Tile:
- 1. Basis of Design Product: WB DWAL 414 manufactured by The Williams Brothers Corporation of America.
 - 2. Description: Recessed access door/panel with touch latches for tile application.

3. Material: Aluminum.
 4. Door: Fully detachable.
 5. Hinges: Concealed.
 6. Recess Depth: As required for tile.
 7. Size: As indicated on Drawings or as required for proper access.
 8. Tile: As indicated on Drawings.
- D. Wall and Ceiling-Mounted Units with Return Air Grille:
1. Basis of Design Product:
 - a. WB GP LV 103 Series Louvered access doors manufactured by The Williams Brothers Corporation of America.
 2. Description: Wall mounted vent cover with diffuser flaps to allow air flow.
 3. Frame: 16 gauge steel.
 4. Door: 14 gauge steel.
 5. Hinges: Fully concealed, standard duty.
 6. Finish: Primed white baked enamel finish.
 7. Mounting: Provide surface-mounted face frame and door surface flush with wall surface.
 8. Size: As indicated on Drawings or as required for proper access.
- E. Wall and Ceiling Mounted Units in Wet Areas:
1. Basis of Design Product: WB AL 1600 Series manufactured by The Williams Brothers Corporation of America.
 2. Description: General use access panel designed for use where moisture is a concern for use in walls and ceilings.
 3. Frame: Aluminum.
 4. Cover: 0.063 lightweight aluminum with radius corners.
 5. Hinges: Continuous Piano Hinge to allow for 180 degree opening.
 6. Finish: Primed white baked enamel finish
 7. Latch: Self latching.
 8. Mounting: Provide surface-mounted face frame and door surface flush with wall surface.
 9. Size: As indicated on Drawings or as required for proper access.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 31 00

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SECTION 08 33 13 - COILING COUNTER DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 06 10 00 - Rough Carpentry.
 - 3. Section 08 71 00 - Door Hardware.
 - 4. Section 09 90 00 - Painting and Coating.
 - 5. Division 26 - Electrical.

1.3 SUBMITTALS

- A. Reference Section 01 33 00 - Submittal Procedures; submit the following items:
 - 1. Product data.
 - 2. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.
 - 3. Quality Assurance/Control Submittals:
 - a. Provide manufacturer ISO 9001 registration.
 - b. Provide manufacturer and installer qualifications - see below.
 - c. Provide manufacturer's installation instructions.
 - 4. Closeout Submittals:
 - a. Operation and Maintenance Manual.
 - b. Certificate stating that installed materials comply with this specification.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer Qualifications: ISO 9001 registered and a minimum of five years experience in producing counter doors of the type specified.
 - 2. Installer Qualifications: Manufacturer's approval.

1.5 DELIVERY STORAGE AND HANDLING

- A. Refer to Section 01 60 00 - Product Requirements.
- B. Follow manufacturer's instructions.

1.6 WARRANTY

- A. Standard Warranty: Two years from date of shipment against defects in material and workmanship
- B. Maintenance: Submit for owner's consideration and acceptance of a maintenance service agreement for installed products.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers listed who produce equivalent products to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 01 requirements regarding substitutions to be considered and approved by Architect:
 - 1. CornellCookson, LLC.: www.cornellcookson.com.

2.2 ELECTRICALLY-OPERATED COILING COUNTER DOORS

- A. Basis of Design:
 - 1. Model ESC10 as manufactured by CornellCookson, LLC.
- B. Curtain:
 - 1. Slat Configuration:
 - a. Aluminum: No. 1F, interlocked flat-faced slats, 1-1/2 inches (38 mm) high by 1/2 inch (13 mm) deep, minimum 0.040 inch aluminum with extruded tubular aluminum bottom bar with continuous lift handle and vinyl astragal.
 - 2. Finish:
 - a. Aluminum: Clear anodized.
- C. Endlocks:
 - 1. Fabricate interlocking slat sections with high strength molded nylon endlocks riveted to ends of alternate slats
- D. Guides:
 - 1. Fabrication:
 - a. Aluminum: Heavy duty extruded aluminum sections with Snap-on cover to conceal fasteners. Provide polypropylene pile runners on both sides of curtain to eliminate metal to metal contact between guides and curtain.
 - 2. Finish:
 - a. Material: Powder coat.
- E. Tube Motor Shaft Assembly:
 - 1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.
- F. Brackets:
 - 1. Fabricate from reinforced steel plate with bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 - a. Finish:
 - 1) Material: Cornell SpectraShield® Coating System.
- G. Hood:
 - 1. Minimum 24 gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4 inch (6.35 mm) steel intermediate support brackets.
 - a. Hood Cover: Where hoods are exposed, cover to match door shall be provided and fully encapsulate wiring and parts.
 - b. Finish:
 - 1) Material: Cornell SpectraShield® Coating System.

2.3 OPERATION

- A. Electric Tube Motor Operator:
 - 1. Rated for a maximum of 10 cycles per day, cULus recognized, rated (50 nm) (100 nm) or (200 nm) as recommended by door manufacturer for size and type of door, 110 Volts, 1 Phase.
 - 2. Provide complete with electric tube motor, maintenance free electric brake, emergency manual crank hoist and control station(s). Motor shall be protected against overload with an auto-reset thermal sensing device.
 - 3. Operator shall be equipped with an emergency manual crank hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual crank hoist.
 - 4. Operator shall be capable of 10-14 RPM. Fully adjustable, mechanical internal worm limit switch mechanism shall synchronize the operator with the door.

5. Electrical Contractor shall mount the control station(s) and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.
- B. Control Station: For use with motor operated units only.
 1. Flush mounted: "Open/Close" key switch with BEST cylinder.
- C. Control Operation:
 1. Constant pressure to close:
 - a. 2-wire, electric sensing edge seal extending full width of door bottom bar. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position. Provide a wireless edge connection to control circuit.

2.4 ACCESSORIES

- A. Locking:
 1. Master Key Cylinder Lock to Owner Standards:
 - a. Operable from coil side of bottom bar. Provide Interlock switches on motor operated units.
 - b. Sargent Key Systems.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

3.2 INSTALLATION

- A. Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.
- B. Follow manufacturer's installation instructions.

3.3 ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion.

3.4 CLEANING

- A. Clean surfaces soiled by work as recommended by manufacturer.
- B. Remove surplus materials and debris from the site.

3.5 DEMONSTRATION

- A. Demonstrate proper operation to Owner's Designated Representative (ODR).
- B. Instruct Owner's Designated Representative (ODR) in maintenance procedures.

END OF SECTION 08 33 13

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SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior non-fire-rated coiling doors.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Door opening jamb and head members.
 - 2. Section 06 10 00 - Rough Carpentry: Door opening jamb and head members.
 - 3. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
 - 4. Section 08 31 00 - Access Doors and Panels: Access doors.
 - 5. Section 08 33 26 - Overhead Coiling Grilles.
 - 6. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test; 2022.
- D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, and component connections and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Samples: Submit two slats, 6 inches (610 mm) in size illustrating shape, color and finish texture.
- E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- F. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.
- G. Executed warranties.
- H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in the Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience and approved by manufacturer.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide five-year manufacturer warranty for three-ply multifilament polyester fabric curtain. Complete forms in Owner's name and register with manufacturer.
- C. Manufacturer Warranty: Provide lifetime manufacturer warranty for counterweights and tension springs. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Overhead Coiling Doors:
 - a. Alpine Overhead Doors, Inc: www.alpinedoors.com.
 - b. Amarr: www.amarr.com/commercial.
 - c. C.H.I. Overhead Doors: www.chiohd.com.
 - d. Clopay Building Products: www.clopaydoor.com.
 - e. Cornell Iron Works, Inc: www.cornelliron.com.
 - f. Hörmann High Performance Doors: www.hormann.us.
 - g. Overhead Door Corporation: www.overheaddoor.com.
 - h. Raynor Garage Doors: www.raynor.com.
 - i. Rite-Hite Corp: www.ritehite.com.
 - j. The Cookson Company: www.cooksondoor.com.
 - k. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 PERFORMANCE / DESIGN CRITERIA

- A. Structural Performance, Exterior Doors:
 - 1. Capable of withstanding the design wind loads:
 - a. Design wind load: As indicated on Drawings.
 - b. Testing: According to ASTM E330/E330M.
 - c. Deflection limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

2.3 NON-INSULATED OVERHEAD COILING DOORS

- A. Overhead Coiling Door: Steel slat curtain.
 - 1. Basis of Design:
 - a. Model ESD10 manufactured by Cornell Iron.
 - 2. Curtain:
 - a. Slats:
 - 1) Galvanized Steel: No. 5F (prefinished), Grade 40 steel, ASTM A653/A653M galvanized steel zinc coating. Gauge as required to meet performance requirements.
 - b. Finish:
 - 1) Powder Coat.
 - (a) Color: As selected by Architect from manufacturer's full line.
 - 3. Endlocks:

- a. Alternate slats each secured with two 1/4 inch (6.35 mm) rivets. Fabricate interlocking sections with high strength nylon. Provide endlocks/windlocks as required to meet specified wind load.
4. Bottom Bar:
 - a. Configuration:
 - 1) Extruded Aluminum: Extruded aluminum alloy 6063-T5.
 - 2) Structural Steel Angles.
 - 3) Structural Aluminum Angles.
 - 4) Heavy Duty Aluminum Bottom Bar: 6 by 2 by 3/8 inches impact resistant tubular extrusion.
 - b. Finish:
 - 1) Powder Coat: Zirconium pre-treatment followed by baked-on polyester powder coat. minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better.
 - (a) Color: As selected by Architect from manufacturer's full line.
5. Counterbalance Shaft Assembly:
 - a. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.
 - b. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs. (110 N). Provide wheel for applying and adjusting spring torque.
6. Brackets:
 - a. Fabricate from minimum 3/16 inch (5 mm) steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 - b. Finish:
 - 1) Powder Coat: Zirconium pre-treatment followed by baked-on polyester powder coat. minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D3363 pencil hardness: H or better.
 - (a) Color: As selected by Architect from manufacturer's full line.
 - 2) Corrosion Inhibitive: Zirconium treatment followed by a corrosion inhibitive baked-on zinc enriched gray polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.
 - 3) Hot-dip Galvanized: ASTM A123/A123M, Grade 85 zinc coating, hot-dip galvanized after fabrication.
 - c. Hood:
 - 1) Galvanized steel with reinforced top and bottom edges. Provide intermediate support brackets as required.
 - 2) Finish:
 - (a) Powder Coat: Zirconium pre-treatment followed by baked-on polyester powder coat. minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D3363 pencil hardness: H or better.
 - (1) Color: As selected by Architect from manufacturer's full line.
7. Weatherstripping:
 - a. Bottom Bar: Replaceable, bulb-style, compressible EDPM gasket extending into guides.
 - b. Guides: Vinyl strip sealing against fascia side of curtain.
 - c. Hood: Neoprene/rayon baffle to impede air flow above coil.
 - d. Lintel Seat: Nylon brush seal fitted at door header to impede air flow.
8. Operation:

- a. Manual Crank Hoist: Provide crank hoist operator including crank gear box, steel crank drive shaft and geared reduction unit. Fabricate gear box to completely enclose operating mechanism and be oil-tight.
- b. Motor: As recommended by manufacturer.
 - 1) Rating: Minimum of 2cycles per hour.
 - 2) Lifecycles: 50,000 cycles.
 - 3) Control Stations:
 - (a) Model: Manufacturer's standard.
 - (b) Location: As indicated on Drawings.
 - 4) Safety Devices: As recommended by manufacturer to comply with applicable regulations.
9. Locking:
 - a. Master keyable cylinder operable from coil side of opening, options for all types of operation. Provide interlock switches or motor mounted interlock switches.
 - 1) Manufactured by Sargent Key Systems.

2.4 INSULATED OVERHEAD COILING DOORS

- A. Exterior, Motorized, Insulated, Overhead Coiling Doors:
 1. Basis of Design Product:
 - a. Thermiser Model ESD20 manufactured by Cornell.
 2. Curtain Material (Exterior Face / Interior Face): Galvanized Steel / Galvanized Steel.
 - a. Manufacturer recommended gauge based on performance requirements. Minimum 24 gauge, Grade 40, ASTM A653/A653M galvanized steel zinc coating.
 3. Insulation: 7/8 inch (22 mm) foamed-in-place, closed cell urethane.
 - a. R-Value: 8.0, minimum.
 4. Curtain Finishes:
 - a. Exterior Finish:
 - 1) Powder Coat.
 - (a) Color: As selected by Architect from Manufacturer's full range.
 - b. Interior Finish:
 - 1) Powder Coat.
 - (a) Color: Gray.
 5. Vision Lites: Dual pane glazed.
 - a. Material: Manufacturer's standard polycarbonate sheet with proprietary abrasion and UV resistant surfaces.
 - b. Size: As indicated in Drawings.
 - c. Spacing: As indicated on Drawings.
 - d. Location on Door Curtain: Dimensionally located on Drawings.
 6. Nominal Slat Size: Refer to Basis of Design product.
 7. Endlocks: Provide windlocks as required to meet specified wind load.
 8. Bottom Bar: Insulated bottom bar.
 - a. Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Minimum 4" tall x 1-1/16" thickness.
 - b. Finish: Match slats.
 9. Guides: Structural steel.
 - a. Minimum 3/16 inch (4.76 mm) angles. Provide windlock bars of same material when windlocks are required to meet specified wind load. Top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
 - b. Top 16-1/2 inches (419 mm) of coil side guide angles to be removable for ease of curtain installation and as needed for future curtain service.
 - c. Finish:

- 1) Powder coat.
 - (a) Color: As selected by Architect from Manufacturer's full range.
10. Counterbalance Shaft Assembly: As recommended by manufacturer.
11. Brackets:
 - a. Material: As recommended by manufacturer.
 - b. Size: As recommended by manufacturer.
 - c. Finish: Match guides.
12. Hood Enclosure:
 - a. Material: As recommended by manufacturer.
 - b. Size: As recommended by manufacturer.
 - c. Finish: Match Curtain.
13. Weatherstripping:
 - a. Bottom Bar:
 - 1) Motorized Doors: Sensing/weather edge with neoprene astragal extending full width of door bottom bar.
14. Operation:
 - a. Manual: Chain hoist operation.
 - b. Motorized:
 - 1) Electric Motor: As recommended by manufacturer.
 - 2) Safety Devices: As required by applicable regulations.
15. Mounting: As indicated on Drawings.
16. Locking Devices:
 - a. Manual Doors: Master keyable cylinder compatible with Sargent Key Systems.
 - b. Motorized Doors: None.
17. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
 - a. Sensing Edge Protection: Pneumatic.
 - b. Operator Controls:
 - 1) Provide controls in locations and mounting indicated on Drawings.
 - c. Motor Voltage: 115/230 single phase, 60 Hz.

2.5 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
 1. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
 2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
- B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

END OF SECTION 08 33 23

SECTION 08 34 73 - SOUND CONTROL DOOR ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sound controls doors and frames.
 - 2. Accessories as required for a complete installation.
- B. Related Sections:
 - 1. Section 08 71 00 - Door Hardware.

1.3 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM D1735 - Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus; 2021.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- D. ASTM E336 - Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings; 2023.
- E. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- F. ASTM E512 - Standard Practice for Combined, Simulated Space Environment Testing of Thermal Control Materials with Electromagnetic and Particulate Radiation; 1994.
- G. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- H. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- I. ASTM International (ASTM):
 - 1. A36 Standard Specification for Carbon Structural Steel.
 - 2. A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 3. A1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 4. A1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 5. E336 Standard Test Method for Measurement of Airborne Sound Insulation in Buildings.
- J. American Welders Society (AWS).
- K. Hollow Metal Manufacturers Association (HMMA): 840 Installation and Storage of Hollow Metal Doors and Frames.
- L. National Fire Protection Agency (NFPA): NFPA 80 Standard for Fire Doors and Fire Windows.
- M. Underwriters Laboratories, Inc. (UL): UL Directory.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements and manufacturer's installation instructions.
 - 2. Manufacturer's installation instructions.

- B. Shop Drawings: Indicate elevations, sections, substrates, fasteners, finishes, hardware, and installation details.
- C. Samples: Samples or color charts showing full range of colors available for Architect's selection.
- D. Certifications:
 - 1. Manufacturer's certification that door construction utilized has been tested at an independent laboratory in accordance with ASTM E90, and that the STC determined in accordance with ASTM E413 is not less than that specified in Part 2 of this Section.
 - 2. Manufacturer's certification that door construction has been tested in accordance with ASTM E512 (UL 10B) for labeled fire doors and frames, and meets requirements of NFPA 80 where required.

1.5 PERFORMANCE REQUIREMENTS

- A. Acoustic Performance: Measure per ASTM E336.
 - 1. Refer to Door Schedule for STC requirements.
- B. Opening Protective: UL labeled, rating as indicated in Door Schedule.

1.6 QUALITY ASSURANCE

- A. Pre-Installation Conference: Refer to Section 01 31 00 - Project Management and Coordination.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store all materials on planks or dunnage in a dry location in a vertical position, spaced by blocking to permit air circulation between units. Cover all materials or store in a controlled area to protect from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Metal Sound Control Door Assemblies:
 - a. AMBICO Limited: www.ambico.com.
 - b. ETS-Lindgren, an ESCO Technologies Company: www.ets-lindgren.com.
 - c. IAC Acoustics: www.iacacoustics.com.
 - d. Krieger Specialty Products Company: www.kriegerproducts.com.
 - e. Megamet Industries, Inc: www.megametusa.com/#sle.
 - f. Overly Door Company: door.overly.com.
 - g. Protective Door Industries: www.protectivedoor.com.
 - h. Wenger Corporation: www.wengercorp.com.

2.2 BASIS OF DESIGN

- A. Products manufactured by Wenger Corporation.

2.3 FABRICATION AND COMPONENTS

- A. Design Features:
 - 1. Vision Lite Configuration: As indicated on Drawings.
 - 2. Hinges: Continuous cam-lift hinges.
 - 3. Seals: Continuous dual magnetic seals.
 - 4. Design Features:
 - a. Innovative isolating crimp design provides a structural connection with minimum sound transmission between panels.
 - b. Absorptive material integrated into the door frame between magnetic seals.
 - c. High quality magnetic seals and hinges provide long life with minimum adjustments (typically once every five years or 100,000 cycles).

- d. Split-frame design for easier installation in many types of wall construction from 4 inchws to 12-1/2 inches in thickness.
 - e. Stainless steel sill plate included.
 - f. Integrated frame support for sill plate.
 - g. Fiberglass backed Teflon® sweep seal to minimize friction in opening and closing the door.
 - h. Door leaf shall be constructed of 12 gauge and 14 gauge steel skins.
 - i. Door frame shall be constructed of 14 gauge steel.
 - j. Vision lites shall be constructed of one (1) lite of 1/4 inch thick and 3/8 inch thick laminated safety glass.
 - k. Mortise pocket is standard for easy lever set integration.
5. Sizes: 3 feet 0 inches by 7 feet 0 inches, 3 feet 6 inches by 7 feet 0 inches, and 4 feet 0 inches by 7 feet 0 inches as indicated or scheduled on Drawings.

2.4 FINISH

- A. Finish: All tool marks and surface imperfections shall be removed, and exposed faces of all welded joints shall be dressed smooth. Assemblies shall be treated and coated on all accessible surfaces with a rust-inhibitive primer that meets ASTM B117 salt spray for 150 hours, and ASTM D1735 water fog test for organic coatings for 200 hours, and that is fully cured prior to shipment.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate with Section 08 71 00 - Door Hardware.

3.2 INSTALLATION

- A. Install Work of this Section in accordance with manufacturer's instructions and approved shop drawings.
- B. Secure the services of a qualified representative of the manufacturer to visit the jobsite and instruct the Contractor's personnel in proper installation and adjustment of the doors and assist, if required, in field tests.

END OF SECTION 08 34 73

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SECTION 08 36 13 - SECTIONAL DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aluminum sectional doors with vision panels.
 - 2. Accessories as required for a complete installation.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 09 90 00 - Painting and Coating.
 - 3. Division 26 - Electrical.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.
- E. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283/E283M or DASMA 105.
- C. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.

1.5 SUBMITTALS

- A. Product Data: Technical data including construction details, material descriptions, dimensions of individual components, profile door sections, and finishes. Include the following:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's operation and maintenance data.
 - 4. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 5. Description of automatic closing device and testing and resetting instructions.
- B. Shop Drawings: Submit plans, elevations, sections, and mounting details.

1. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 3. Include diagrams for power, signal, and control wiring.
- C. Performance Standards:
1. Door Section: Gloss retention, fade resistance, FDA compliance, cold crack performance, load to rebound, dent resistance impact.
 2. Drive Train: Spring cycle life, track, hinges, rollers, cable assembly, cable strength
 3. Door Assembly: Thermal performance, deflection, wind load.
- D. Selection Sample: For each finish product specified, two (2) complete sets of color chips representing manufacture's full range of available colors and patterns.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Building Code: Comply with applicable requirements of the IBC.
 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 3. Accessibility Requirements: Comply with applicable requirements.
 - a. Texas Accessibility Standards (TAS).
- B. Installer Qualifications: Company specializing in installing sectional doors with minimum five (5) years' experience and approved by or authorized representative of the manufacturer.
- C. Pre-Installation Conference: Conduct on project site.

1.7 WARRANTY

- A. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components that show evidence of deterioration of factory applied finishes within specified warranty period.
1. Warranty Period: Ten years from date of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in labeled protective packages.
- B. Store and handle in compliance with manufacturer's instructions and recommendations.
- C. Protect from damage from weather, excessive temperatures, and construction operations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

1. Aluminum Sectional Doors
 - a. C.H.I. Overhead Doors, Inc.
 - b. Clopay Building Products.
 - c. Fimbel Architectural Door Specialties.
 - d. Overhead Door Corporation.
 - e. Raynor; www.raynor.com/#sle
 - f. Rite-Hite Corporation.
 - g. Wayne-Dalton Corp.
 - h. Windsor Door.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 ALUMINUM SECTIONAL DOORS WITH VISION PANELS

- A. Basis of Design: "OPTIMA Sectional Rail and Stile Door" manufactured by AlumaView.
- B. Sectional Door Assembly:
 1. Aluminum door assembly with rabbeted meeting rails to form weathertight joints and provide full-width interlocking structural rigidity. Units shall have the following characteristics:
 - a. Panel thickness: 2 inches thick 6063T6 aluminum alloy frame.
 - b. 0.050-inch thick aluminum panels.
 - c. Stiles and rails to be joined together with 5/16 inch diameter screws (per mfr).
 - d. Panels and glass to be held in place with a dual durometer snap-in.
 - e. Top rails to be 2-13/16 inches .
 - f. End stiles shall be 2-7/8 inches.
 - g. Center stiles to be 2-5/8 inches.
 - h. Bottom rail of door to have vinyl weather-strip to seal door to floor.
 - i. Extrusions and panels to etched and clear anodized to meet Spec 204R1.
 - j. Doors with Full Glass: Refer to Drawings.
 - k. Locking: Cremone type bolt engages slot in track, right hand side five-pin tumbler cylinder outside – night latch inside.
 - l. Glazing: DSBT Glass by Raynor; 1/2 inch, clear insulated.
 - m. Tracks: 2 inch hot-dipped galvanized track, per ASTM A653/A653M, to be bracket mounted or continuous angle mounted and fully adjustable for sealing door to jamb. Continuous angle size to be not less than 2-5/16 inches by 5 inches by 3/32 inch. Horizontal track to be adequately reinforced with continuous angle. Hinges and brackets made from galvanized steel.
 - n. Springs counterbalance: Heavy duty oil - tempered wire tension springs on a continuous ball bearing cross-header shaft. Galvanized aircraft type lifting cables with minimum safety factor of 5 to 1 (70K cycle springs required). Leaf spring bumpers required.
 - o. Head seal and jamb seal required.
- C. Finish and Color: Armorbright finish coating in color to be selected by Architect.
- D. Windload Design: Door assembly shall be capable of resisting, at a minimum, a nominal wind loading of +36psf/-41psf as defined by ASCE 7 and as justified by either engineering analysis and/or testing in conformance with DSA IR A-5.
- E. Powerhoist standard "PHST"-311, trolley type electric operator, 1/3 hp, 115 V, single phase with one (1) three-button control; station v-belt drive to full ball bearing power train with additional reduction by chain and sprockets.

- F. Balance of door operations by door manufacturer.

2.3 DOOR OPERATION

- A. Motorized Door Operator:
 - 1. Usage Classification: Light duty, up to 10 cycles per hour.
 - 2. Operator Type: Jackshaft, center mounted.
 - 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
 - 4. Motor Exposure: In locations indicated on Drawings.
 - 5. Emergency Manual Operation: Push-up.
 - 6. Obstruction Detection Device: Automatic photoelectric sensor.
 - 7. Control Station: Interior side mounted.

PART 3 EXECUTION

3.1 PREPARATION

- A. Take field dimension and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.
- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- C. Verify electric power is available and of correct characteristics.

3.2 INSTALLATION

- A. Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- B. Anchor assembly to wall construction and building framing without distortion or stress.
- C. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- D. Fit and align door assembly including hardware.
- E. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

3.3 ADJUSTING AND CLEANING

- A. Fit, align, and adjust door assemblies level and plumb.
- B. Clean doors of dirt and grease.
- C. Remove labels and visible markings, except those required by UL and authorities having jurisdiction.
- D. Test sectional doors for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- E. Touch-up damaged coatings and finishes, and repair minor damage. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.
- F. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- G. Protect installed products until completion of Project.
- H. Touch-up damaged coatings and finishes and repair minor damage before Substantial Completion.

- I. Instruct Owner's personnel in proper operating procedures and maintenance schedule.

END OF SECTION 08 36 13

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SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Exterior and interior storefront framing.
 - 2. Exterior and interior manual swing entrance doors.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 05 12 00 - Structural Steel Framing.
 - 2. Section 05 40 00 - Cold Formed Metal Framing.
 - 3. Section 05 50 00 - Metal Fabrications.
 - 4. Section 07 62 00 - Roof Related Sheet Metal.
 - 5. Section 07 92 00 - Joint Sealants.
 - 6. Section 08 13 16 - Aluminum Doors.

1.3 REFERENCE STANDARDS

- A. 2012 TAS - Texas Accessibility Standards; 2012.
- B. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- K. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.
- L. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.

1.4 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.
- B. Shop Drawings:
 - 1. Submit aluminum storefront framing and entrances shop drawings including plans, elevations, sections, full size details, and attachments to other work:
 - a. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - b. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- D. Engineer's calculations of performance requirements.
- E. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.5 PERFORMANCE REQUIREMENTS

- A. Aluminum framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or fail due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
- B. Structural Loads:
 - 1. Wind loads: 132 MH (3-Second Gust) Ultimate wind speed ; exposure C.
- C. Deflection of Framing Members:
 - 1. Deflection normal to wall plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
 - 2. Deflection parallel to glazing plane: Limited to $L/360$ of clear span or 1/8 inch (3.2 mm), whichever is smaller.
- D. Structural Test Performance - Provide aluminum framed systems tested according to ASTM E330/E330M as follows:
 - 1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E331 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Windborne Debris Impact Resistance:
 1. Pass missile impact and cyclic pressure tests when tested according to ASTM E1886 and testing information in ASTM E1996 for Wind Zone 2a:
 - a. Large missile test: For glazed openings located within 30 feet (9.1 m) of grade.
- H. Thermal Movements:
 1. Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss:
 - a. Temperature change (range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 - b. Interior ambient-air temperature: 75 degrees F (24 degrees C).
- I. Condensation Resistance: Provide aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- J. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Accessibility requirements:
 - a. 2019 California Building Code: Section 11B-404.3 accessible route.
 - b. 2019 California Building Code: Section 11B-309.4 operable parts interior usage.
 - c. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - d. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
- B. Installer Qualifications: Installer having minimum 10 years' documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.
- C. Engineering Responsibility: Prepare data for aluminum framed systems, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.
- D. Product Options:
 1. Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance:

- a. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Source Limitations: Obtain aluminum framed entrances from single source from single manufacturer.
- F. Pre-Installation Conference: Conduct conference at site.

1.7 WARRANTY

- A. Written warranty signed by manufacturer, Contractor, and installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Water leakage through fixed glazing and framing areas.
 - d. Failure of operating components.
 - 2. Warranty period: 2 years from date of Substantial Completion.
- B. Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering:
 - 1. Warranty period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufactureres:
 - 1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. Kawneer: www.kawneer.us.
 - b. Oldcastle BuildingEnvelope: www.obe.com.
 - c. Tubelite, Inc.: www.tubeliteusa.com.
 - d. US Aluminum Corporation: www.usalum.com.
 - e. YKK America AP, Inc.: www.ykkap.com.
 - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- B. Basis of Design:
 - 1. Standard Systems:
 - a. Trifab VersaGlaze 451 and 451T manufactured by Kawneer.
 - 2. Impact Resistant Systems:
 - a. Trifab 601 and 601T manufactured by Kawneer.
- C. General:
 - 1. Maximum design pressure +/- 45 psf.
 - 2. Refer to Drawings for frame size and locations. Subject to compliance with requirements, provide comparable storefront system by one of the following:
- D. Aluminum:
 - 1. Alloy and temper recommended by manufacturer for type of use and finish indicated:
 - a. Sheet and plate: ASTM B209/B209M.
 - b. Extruded bars, rods, profiles, and tubes: ASTM B221/ASTM B221M.

- c. Extruded structural pipe and tubes: ASTM B429/B429M.
- E. Framing Members:
 - 1. Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads:
 - a. Construction: Non-Thermal or Thermal, as indicated on Drawings.
 - b. Glazing system: Retained mechanically with gaskets on four sides.
 - c. Glazing Plane: Center.
- F. Accessories:
 - 1. Brackets and reinforcements: High strength aluminum with nonstaining, nonferrous shims for aligning system components.
 - 2. Fasteners and accessories:
 - a. Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials:
 - 1) Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2) Reinforce members as required to receive fastener threads.
 - 3. Concrete and masonry inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
 - 4. Concealed flashing: Corrosion resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
 - 5. Framing system gaskets and sealants: Recommended by manufacturer for joint type.
- G. Glazing:
 - 1. Refer to Section 08 80 00 - Glazing for impact resistant laminated insulating glazing units
 - 2. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
 - 3. Spacers and Setting Blocks: Elastomeric type.
- H. Entrance Doors:
 - 1. Refer to Section 08 13 16 - Aluminum Doors.
- I. Accessories:
 - 1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 - Joint Sealants.
 - 2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) 30 mil (0.762 mm) thickness per coat.

2.2 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members:
 - 1. Fabricate components that, when assembled, have specified characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - d. Physical and thermal isolation of glazing from framing members.
 - e. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - f. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 - g. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- h. Provide sill receptors with end dams at all sill conditions.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Storefront Framing: Fabricate components for assembly using screw spline system.
- E. Entrance Door Frames:
 - 1. Reinforce as required to support loads imposed by door operation and for installing entrance door hardware:
 - a. At exterior doors, provide weather stripping at fixed stops.
 - b. At interior doors, provide weather stripping at stops to prevent metal to metal contact.
- F. After fabrication, clearly mark components to identify their locations in Project according to shop drawings.

2.3 ALUMINUM FINISHES

- A. Color: Clear Anodized.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on shop drawings.

3.2 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.3 INSTALLATION

- A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work:
 - 1. Do not install damaged components.
 - 2. Fit joints to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure nonmovement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 5. Seal joints watertight unless otherwise indicated.
 - 6. Min anchorage #8 with 2 inch minimum embedment; minimum 2 inches from edges. Refer to shop drawings.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing specified in Section 08 80 00 - Glazing.

- G. Entrance Doors and Hardware:
 - 1. Install doors to produce smooth operation and tight fit at contact points:
 - a. Exterior doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - b. Field installed entrance door hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

3.4 ERECTION TOLERANCES

- A. Install aluminum framed systems to comply with the following maximum erection tolerances:
 - 1. Location and plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.5 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer:
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3 second closer sweep period for doors to move from a 70 degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

3.6 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
 - 1. Maintenance tools and instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 - 2. Initial maintenance service: Beginning at Substantial Completion, provide six (6) months full maintenance by skilled employees of entrance door hardware installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

END OF SECTION 08 43 13

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SECTION 08 56 73 - SOUND CONTROL WINDOWS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Factory Preglazed Sound Control Window assemblies including all accessories for complete construction.
- B. Related Sections:

1.3 REFERENCE STANDARDS

- A. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- B. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- C. UL 752 - Standard for Bullet-Resisting Equipment; Current Edition, Including All Revisions.

1.4 COORDINATION

- A. Coordinate installation of anchorages for windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachments to other work.
 - 2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
 - 3. Location of weep holes.
 - 4. Glazing details.
- C. Samples for Initial Selection: For frame members with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Framing: 12 inch (305 mm) long sections of frame members.
- E. Cutaway Sample: Corner of window, made from 12 inch (305 mm) lengths of full-size components, and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Glazing.
 - 4. Flashing and drainage.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Pack windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label window packaging with drawing designation.
- C. Store crated windows on raised blocks to prevent moisture damage.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.10 SEQUENCING

- A. Field Painting: Except where windows have been preglazed before installation, complete field painting of windows before glazing installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including deflections exceeding 1/4 inch (6 mm).
 - b. Failure of welds.
 - c. Excessive air leakage.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. IAC Acoustics: www.iacacoustics.com.
 - 2. Noise Barriers, LLC.: www.noisebarriers.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 BASIS OF DESIGN

- A. QuietLite HM-53 manufactured by Noise Barrier, LLC.

2.3 MATERIALS

- A. Window frames shall be 1-1/4 inch (32 mm) thick fabricated from not less than 12 gauge steel, reinforced and filled with sound-absorbing acoustic fill, Inside and outside corners shall be mitered and interlocked to hairline measurements, made square, continuously welded, and ground smooth, flush, and invisible.
- B. Stops shall be up to 1 inch (25 mm) thick and readily removable, fabricated from not less than 16 gauge rolled steel sections predrilled and aligned with frame to form tight square acoustical joint. Stop fasteners shall be concealed.

- C. Acoustic seals for glazing shall be vibration-isolating resilient closed-cell polyethylene foam glazing tape. Glazing tape must be designed to withstand environmental breakdown and maintain an effective seal. Self-contained, sound-absorptive interior perimeter of not less than 22 gauge steel shall be perforated and prefinished black. Desiccant material shall be incorporated into multiple glazed units.
- D. Assembly of acoustic window units including frames, stop, glazing, acoustic seals, sound-absorbing material, and concealed fasteners shall take place at the factory to insure required noise reduction is achieved. Glazing shall not need to be removed to facilitate fastening or anchoring at the job site.
- E. Finish: Unless otherwise specified, steel window frame assemblies shall receive one shop coat of gray primer. Stainless steel shall not be painted.
- F. Lights for single-and double-glazed units shall be minimum 1/4 inch (6 mm) laminated safety glass consisting of multi-layer clear float with clear plastic interlayer. Bullet-resistant glazing (if required) shall be certified to meet UL 752 specifications.

2.4 ACOUSTICAL PERFORMANCE CHARACTERISTICS

- A. At least 10 days prior to bidding, manufacturer shall submit laboratory test data certifying Sound Transmission Loss and Sound Transmission Class (STC) when tested in accordance with ASTM E90 of not less than the following:
- B. Sound Transmission Loss, db:

2.5 OCTAVE BAND CENTER FREQUENCY, HZ

125	250	500	1K	2K	4K	STC
38	43	49	56	59	62	53

2.6 FABRICATION

- A. Assemble windows using all welded construction conforming to pertinent requirements of AWS D1.1/D1.1M. Assembly and adjustment of window units, frames, stop, glazing, acoustic seals, sound-absorbing material and concealed fasteners shall be performed at the factory. Each entire unit shall be shipped to the job site ready for installation and subsequent operation.
 - 1. Reinforce as required to withstand operating loads.
 - 2. Painting and cleaning:
 - a. On surfaces that are inaccessible after assembly, apply protective coating of the manufacturer's standard rust-inhibitive primer.
 - b. After assembly, and prior to inspection, thoroughly clean all surfaces.
 - c. After inspection, and completion of repairs and revisions required by the inspection, apply a shop coat of rust inhibitive primer to exposed surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of windows.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of window connections before window installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of windows.
- D. Inspect built-in and cast-in anchor installations, before installing windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
 - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.

2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
- E. For glazing materials whose orientation is critical for performance, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other window anchors whose installation is specified in other Sections.
 1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing windows to in-place construction. Include threaded fasteners for inserts, fasteners, and other connectors.
 1. Install an attached or integral flange to secure side of windows extending over rough-in opening gap so that gap has same forced-entry-resistance and ballistics-resistance performance as window.
- B. Glazed Framing: Provide sealant and gasket-glazed framing.
- C. Fasteners: Install windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.
- D. Sealants: Comply with requirements in Section 07 92 00 - Joint Sealants for installing sealants, fillers, and gaskets.
 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.
- E. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Perform additional inspections to determine compliance of replaced or additional Work. Prepare inspection reports.
- C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.5 ADJUSTING

- A. Adjust windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
- B. Remove and replace defective Work, including windows that are warped, bowed, or otherwise unacceptable.

3.6 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.

- B. Provide temporary protection to ensure that windows are without damage at time of Substantial Completion.

3.7 ACCEPTANCE OF TESTING

- A. Before acceptance of the installed Sound Control Window Units, and at any time within the project guaranteed period, The Owner and The Architect may request that acoustic performance testing of the installations be performed. Ideally, this testing shall be performed by an independent acoustics consultant at the expense of the Installing Contractor.
- B. The installations shall be deemed acceptable if the Sound Control Window Units meet or exceed a Noise Isolation Class (NIC) that is not more than six (6) points below the specified STC rating.

END OF SECTION 08 56 73

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SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Stile and Rail Wood Doors".
 - 4. Division 08 Section "Sound Control Hollow Metal Door Assemblies".
 - 5. Division 08 Section "Sound Control Wood Door Assemblies".
 - 6. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 7. Division 28 Section "Access Control Hardware Devices".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.

2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.

- c. Wiring instructions for each electronic component scheduled herein.
- 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 1. Manufacturers:
 - a. Pemko (PE) - EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
- B. Electrified Quick Connect Data Transfer Hinges: Provide combined electrified power and Ethernet data transfer hinges with Molex™ standardized plug connectors to accommodate electrified functions with a 1-year warranty as specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 1. Data transfer hinges feature two 6-position and two 4-position Molex connectors, 9 multi-strand wires; 2 twisted pairs (26 AWG), 4 straight conductors (28 gauge) and 1 straight conductor (22 AWG) with concealed plug connectors eliminating the need for separate or exposed wiring. Rated 350 mA continuous @ 48 volts DC nominal, the hinge is capable of two PoE wiring configurations:
 - a. Power over Data (5 wire): Power and Data supplied together over the 2 twisted 26 AWG pairs. The 22 AWG conductor is used for the earth ground connection.

- b. Data with Power over Spares (9 wire): Data over 2 twisted (26 AWG) pairs with Power over spare pairs 94 straight 28 AWG conductors). The 22 Awg conductor is used for earth ground connection.
- 2. Manufacturers:
 - a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR) - PoE Series.
 - b. McKinney (MK) - PoE Series.
 - c. Pemko (PE) - PoE Series.
- C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
 - 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.
 - 2. Manufacturers:
 - a. McKinney (MK) - QC-C Series.

2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
 - 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 - 2. Furnish dust proof strikes for bottom bolts.
 - 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 - 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 - 5. Manufacturers:
 - a. Rockwood (RO).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 - 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.

2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:
 - a. Rockwood (RO).

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Match Facility Standard.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. Existing System: Field verify and key cylinders to match Owner's existing system.
- D. Key Quantity: Provide the following minimum number of keys:
 1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. Key Registration List (Bitting List):
 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.6 CYLINDRICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.
 - 1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 10X Line.
 - b. No Substitution.

2.7 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. Exit devices shall have a five-year warranty.

2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
 7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
 - e. Five-year limited warranty for electromechanical features.
 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.

- b. No Substitution.

2.9 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.
 - b. No Substitution.

- C. Electromechanical Sliding Door Operators (Moderate/High Traffic): Provide low energy operators that comply with requirements for the Americans with Disabilities Act (ADA). Operators shall accommodate openings up to 400 pounds and 36" wide. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide operators with functions and features as follows:
 - a. Adjustable 0-24 second open time.
 - b. Three operation modes: auto with open-assist, hold open and lock modes.
 - c. Activation via push button, keypad or wave sensor as specified.
 - d. Customizable DIP switches for power level for lightweight or heavy doors, slam-shut functionality and beeper alerts.
2. Manufacturers:

- a. Pemko (PE) - PemkoMatic Series.
- b. No Substitution.

2.10 ARCHITECTURAL TRIM

A. Door Protective Trim

- 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
- 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
- 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
- 4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, .050-inch thick.
- 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
- 6. Manufacturers:
 - a. Rockwood (RO).

2.11 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Rockwood (RO).
 - c. Sargent Manufacturing (SA).

2.12 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko (PE).

2.13 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.
 - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SA - SARGENT
4. SU - Securitron
5. RO - Rockwood
6. OT - Other

Hardware Sets

Set: 1.0 (NOT USED)

Description: EXTERIOR ACCESS CONTROL LOCK

1 Continuous Hinge	CFMxxHD1 PT		PE
1 Access Control Mort Lock	SN200-82271-24V LNL	US26D	SA
1 Electric Power Transfer	EL-CEPT	630	SU
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
1 ElectroLynx Harness (Cat 5)	PoE-C300PRJ		MK
1 DPS	by security		OT

Notes: Door is normally closed and locked.
When presented with valid credentials, reader unlocks door.
During power failure or fire alarm, lock is battery powered and door remains locked (fail secure).
REX switch within lock allows free egress at all times.

Set: 2.0 (NOT USED)

Description: EXTERIOR EXIT W/ ACCESS CONTROL

1 Continuous Hinge	CFMxxHD1 PT		PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Rim Exit Device	LD 43 56 SN200 8804 ETL	US32D	SA

1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Wiring Diagram	WD-SYSPK		SA
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
1 DPS	by security		OT
1 ElectroLynx Harness	QC-C1500P		MK
1 ElectroLynx Harness	QC-Cxxx		MK

Notes: Door is normally closed and locked.
When presented with valid credentials, integrated reader unlocks door.
During power failure or fire alarm, door remains locked (fail secure).
REX switch within lock allows free egress at all times.

Set: 3.0

Doors: J121G, J121H, J121M, J121N, J121P, J121Q
Description: OVERHEAD DOOR

1 Cylinder	match Huffman ISD standards	US32D	SA
1 Keyswitch	MKA		SU

Notes: Hardware by door supplier. Verify cylinder requirements, if any.

Set: 4.0

Doors: H107, H121A
Description: CLASSROOM

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Office/Entry Lock	V04 8205 LL	US26D	SA
2 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Floor Stop	441CU	US26D	RO
1 Gasketing	S88BL		PE

Set: 5.0

Doors: H103C
Description: BREAKROOM

3 Hinge, Full Mortise	TA2714	US26D	MK
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1 Classroom Lock	8237 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

Set: 6.0

Doors: H105, H114

Description: STORAGE PAIR

8 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom/Closet Lock	8204 LL	US26D	SA
1 Surface Bolt	580-12 top only	US26D	RO
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
2 Floor Stop	441CU	US26D	RO
2 Silencer	608-RKW		RO

Set: 7.0

Doors: H118

Description: STORAGE YARD

1 Continuous Hinge	CFMxxHD1		PE
1 Storeroom/Closet Lock	8204 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE

Set: 8.0

Doors: H126

Description: GATE

1 Cylinder	match Huffman ISD standards	US32D	SA
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Notes: Hardware by chain link gate manufacturer. Verify cylinder requirements, if any.

PBK Architects
Project No. 240157

New CTE Center & Hargrave High School Additions & Renovations
Huffman Independent School District

END OF SECTION 08 71 00

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 4. Division 28 Section "Access Control Hardware Devices".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 - Access Control System Units.
 - 4. UL 305 - Panic Hardware.

5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 CONTINUOUS HINGES

- A. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.
 1. Manufacturers:
 - a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
 - b. Pemko (PE).

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 1. Manufacturers:
 - a. Pemko (PE) - EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-

door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.
2. Manufacturers:
 - a. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 2. Furnish dust proof strikes for bottom bolts.
 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 5. Manufacturers:
 - a. Rockwood (RO).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 6. Manufacturers:
 - a. Rockwood (RO).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 - 4. Tubular deadlocks and other auxiliary locks.
 - 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 6. Keyway: Match Facility Standard.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
 - 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 - 3. Existing System: Field verify and key cylinders to match Owner's existing system.
- D. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Level/Group): Five (5).
 - 3. Construction Keys (where required): Ten (10).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.7 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical locksets shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are available in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Motorized electric latch retraction where the latchbolt retracts in 0.5 seconds of power being applied; removing power allows the latch to project back to the extended position. Motorized latch retraction force exceeds ANSI/BHMA 50 lbs. warped door test.
 - d. Options to be available for request-to-exit or enter signaling, latchbolt and deadbolt monitoring.
 - e. Optional high security monitoring with internal end-of-line monitoring alongside deadbolt privacy and integrated door position monitoring.
 - f. Two-year limited warranty on electrified functions.
 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 8200 Series.
 - b. No Substitution.

2.8 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 4. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
 2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
 7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
 - e. Five-year limited warranty for electromechanical features.
 2. Manufacturers:

- a. Sargent Manufacturing (SA) - 80 Series.
- b. No Substitution.

2.10 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

- 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
- 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
- 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
- 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
- 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
- 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

- 1. Heavy duty surface mounted door closers shall have a 30-year warranty.
- 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.
 - b. No Substitution.

C. Electromechanical Sliding Door Operators (Moderate/High Traffic): Provide low energy operators that comply with requirements for the Americans with Disabilities Act (ADA). Operators shall accommodate openings up to 400 pounds and 36" wide. Listed manufacturers shall meet all functions and features as specified herein.

- 1. Provide operators with functions and features as follows:
 - a. Adjustable 0-24 second open time.
 - b. Three operation modes: auto with open-assist, hold open and lock modes.
 - c. Activation via push button, keypad or wave sensor as specified.
 - d. Customizable DIP switches for power level for lightweight or heavy doors, slam-shut functionality and beeper alerts.
- 2. Manufacturers:

- a. Pemko (PE) - PemkoMatic Series.
- b. No Substitution.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

- 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
- 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
- 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
- 4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
- 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
- 6. Manufacturers:
 - a. Rockwood (RO).

2.12 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Norton Rixson (RF).

- b. Rockwood (RO).
- c. Sargent Manufacturing (SA).

2.13 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko (PE).

2.14 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a

hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. MR - Markar
3. PE - Pemko
4. SA - SARGENT
5. SU - Securitron
6. RO - Rockwood
7. OT - Other

Hardware Sets

Set: 1.0

Doors: **220**

Description: EXTERIOR ACCESS CONTROL LOCK

1 Continuous Hinge	CFMxxHD1 PT		PE
1 Access Control Mort Lock	SN200-82271-24V LL	US26D	SA
1 Electric Power Transfer	EL-CEPT	630	SU
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Wiring Diagram	WD-SYSPK		SA
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
1 DPS	by security		OT
1 ElectroLynx Harness	QC-C1500P		MK
1 ElectroLynx Harness	QC-Cxxx		MK

Notes: Door is normally closed and locked.

When presented with valid credentials, reader unlocks door.
During power failure or fire alarm, lock is battery powered and door remains locked (fail secure).
REX switch within lock allows free egress at all times.
Refer to door schedule.

Set: 1.1

Doors: 213

Description: EXTERIOR STOREROOM LOCK

1 Continuous Hinge	CFMxxHD1		PE
1 Storeroom/Closet Lock	8204 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE

Set: 1.2

Doors: 130A.2

Description: EXTERIOR ALUMINUM ACCESS CONTROL LOCK

1 Continuous Hinge	CFMxxHD1 PT		PE
1 Access Control Mort Lock	SN200-82271-24V LL	US26D	SA
1 Electric Power Transfer	EL-CEPT	630	SU
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
1 DPS	by security		OT
1 ElectroLynx Harness	QC-C1500P		MK
1 ElectroLynx Harness	QC-Cxxx		MK

Notes: Balance of weatherstripping by aluminum door manufacturer. Provide brackets and spacers as required for door closers.

Door is normally closed and locked.
When presented with valid credentials, reader unlocks door.
During power failure or fire alarm, door remains locked (fail secure).
REX switch within lock allows free egress at all times.
Refer to door schedule.

Set: 2.0

Doors: 110.1, 110.2

Description: INTERIOR ALUMINUM ACCESS CONTROL LOCK

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Access Control Mort Lock	SN200-82271-24V LL	US26D	SA
1 Electric Power Transfer	EL-CEPT	630	SU
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Wiring Diagram	WD-SYSPK		SA
1 Power Supply	by security		OT
1 DPS	by security		OT
1 ElectroLynx Harness	QC-C1500P		MK
1 ElectroLynx Harness	QC-Cxxx		MK

Notes: Balance of weatherstripping by aluminum door manufacturer. Provide brackets and spacers as required for door closers.

Set: 3.0

Doors: 112.1, 112.2, 126, 211

Description: INTERIOR ACCESS CONTROL LOCK

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Access Control Mort Lock	SN200-82271-24V LL	US26D	SA
1 Electric Power Transfer	EL-CEPT	630	SU
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Wiring Diagram	WD-SYSPK		SA
1 Power Supply	by security		OT
1 DPS	by security		OT
1 ElectroLynx Harness	QC-C1500P		MK
1 ElectroLynx Harness	QC-Cxxx		MK

Notes: Balance of weatherstripping by aluminum frame manufacturer.

Set: 4.0

Doors: 101.4

Description: INTERIOR ALUMINUM PAIR

6 Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1 Mullion	L980A	US28	SA
1 Rim Exit Device, Storeroom	16 43 8804 ETL	US32D	SA
1 Rim Exit Device, Exit Only	16 43 8810 EO	US32D	SA

4 Cylinder	match Huffman ISD standards	US32D	SA
2 Surface Closer	351 PS	EN	SA

Notes: Balance of weatherstripping by aluminum door manufacturer. Provide brackets and spacers as required for door closers.

Set: 5.0

Doors: 100.1, 100.2, 101.1, 101.2, 102, 104, 200

Description: ALUMINUM EXTERIOR PAIR W/ ACCESS CONTROL

2 Continuous Hinge	CFMxxHD1 PT		PE
1 Mullion	L980A	US28	SA
2 Electric Power Transfer	EL-CEPT	630	SU
1 Rim Exit Device, Exit Only	16 43 55 8810 EO	US32D	SA
1 Rim Exit Device	LD 43 56 SN200 8804	US32D	SA
1 Vandal Resistant Trim	826	US32D	SA
3 Cylinder	match Huffman ISD standards	US32D	SA
2 Surface Closer	351 PS	EN	SA
1 Wiring Diagram	WD-SYSPK		SA
2 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
2 DPS	by security		OT
2 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-Cxxx		MK

Notes: Door is normally closed and locked.
When presented with valid credentials, integrated reader unlocks door.
During power failure or fire alarm, door remains locked (fail secure).
REX switch within lock allows free egress at all times.

Balance of weatherstripping by aluminum door manufacturer. Provide brackets and spacers as required for door closers.

Set: 6.0

Doors: 101.3

Description: INTERIOR EXIT PAIR W/ ACCESS CONTROL

2 Continuous Hinge	CFMxxHD1 PT		PE
1 Mullion	L980A	US28	SA
2 Electric Power Transfer	EL-CEPT	630	SU
1 Rim Exit Device	LD 43 56 SN200 8804 ETL	US32D	SA
1 Rim Exit Device, Exit Only	16 43 55 8810 EO	US32D	SA
3 Cylinder	match Huffman ISD standards	US32D	SA

2 Surface Closer	351 PS	EN	SA
2 Kick Plate	K1050 10" x LAR	US32D	RO
1 Wiring Diagram	WD-SYSPK		SA
2 Silencer	608-RKW		RO
1 Power Supply	by security		OT
2 DPS	by security		OT
2 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-Cxxx		MK

SET 7.0 (NOT USED)

Set: 8.0

Doors: 215, 217, 219

Description: EXTERIOR STORAGE PAIR

2 Continuous Hinge	CFMxxHD1		PE
1 Storeroom/Closet Lock	AV 8204	US32D	SA
2 Surface Bolt	580-12	US26D	RO
1 Vandal Resistant Trim	826	US32D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
2 Kick Plate	K1050 10" x LAR	US32D	RO
2 Floor Stop	441CU	US26D	RO
1 Astragal	303AS		PE
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
2 Sweep	315CN		PE
1 Threshold	2005AV		PE

Set: 9.0

Doors: 201A.1, 205A.1

Description: EXTERIOR EXIT W/ ACCESS CONTROL

1 Continuous Hinge	CFMxxHD1 PT		PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Rim Exit Device	LD 43 56 SN200 8804	US32D	SA
1 Vandal Resistant Trim	826	US32D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Wiring Diagram	WD-SYSPK		SA
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE

1 Sweep	315CN	PE
1 Threshold	2005AV	PE
1 Power Supply	by security	OT
1 DPS	by security	OT
1 ElectroLynx Harness	QC-C1500P	MK
1 ElectroLynx Harness	QC-Cxxx	MK

Notes: Door is normally closed and locked.
When presented with valid credentials, integrated reader unlocks door.
During power failure or fire alarm, door remains locked (fail secure).
REX switch within lock allows free egress at all times.

Set: 10.0

Doors: 123.2, 123.3, 127.2, 127.3, 130A.3, 201A.2, 201A.3, 201A.4, 202A.2, 202A.3, 202A.4, 205A.4, 220A, 220B, 303, 305

Description: HARDWARE BY OTHERS

1 Cylinder	match Huffman ISD standards	US32D	SA
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Notes: Hardware by door supplier. Verify cylinder requirements, if any.

Set: 11.0

Doors: 103B, 103C, 103D, 114, 120B, 121B, 124, 125A.1, 125A.2, 130A.1, 130C, 131B, 132B, 132C, 138, 201B.1, 202H, 204A, 205B, 206C, 217.1, 301

Description: STORAGE

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom/Closet Lock	V01 8204 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

Set: 11.1

Doors: 120A

Description: BUSINESS STORAGE

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	8237 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

Set: 12.0

Doors: 135

Description: STORAGE PAIR

8 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom/Closet Lock	8204 LL	US26D	SA
1 Surface Bolt	580-12 top only	US26D	RO
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
2 Floor Stop	441CU	US26D	RO
2 Silencer	608-RKW		RO

Set: 13.0

Doors: 119, 121A, 130B, 130D, 131A, 133, 202C, 206A

Description: OFFICE W/ CLOSER

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Entry Lock	V04 8205 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

Set: 13.1

Doors: 111, 113, 115, 116, 117

Description: OFFICE

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Entry Lock	V04 8205 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

Set: 14.0

Doors: 204C.1, 204C.2

Description: STC DOOR

1 Continuous Hinge	FM300	630	MR
1 Classroom Lock	8237 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Floor Stop	441CU	US26D	RO

1 Gasketing	S88BL	PE
1 Door Bottom	4131CRL	PE
1 Threshold	171A	PE

Set: 15.0

Doors: 118

Description: STAFF SINGLE USE RESTROOM

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Privacy Lock	49 8265 LL	US26D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Floor Stop	441CU	US26D	RO
1 Gasketing	S88BL	PE	

Set: 16.0

Doors: 122, 125B, 202D

Description: SINGLE USE RESTROOM

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Institutional Privacy Lock	49 8267 LL	US26D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Floor Stop	441CU	US26D	RO
1 Gasketing	S88BL	PE	

Set: 17.0

Doors: 120, 121, 123.1, 125.1, 125.2, 127.1, 130.2, 132.1, 132.2, 134, 201, 201A.5, 202.1, 202.2, 202.3, 202.4, 202B, 203.1, 203.2, 204, 205, 205A.2, 205A.3, 206

Description: CLASSROOM

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Entry Lock	V04 8205 LL	US26D	SA
2 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Floor Stop	441CU	US26D	RO
1 Gasketing	S88BL	PE	

Set: 17.1

Doors: 131

Description: LAW ENFORCEMENT

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Classroom Lock	8237 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA

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1 Surface Closer	351 O / P10	EN	SA
1 Floor Stop	441CU	US26D	RO
1 Gasketing	S88BL		PE

END OF SECTION 08 71 00

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
 - 4. Division 28 Section "Access Control Hardware Devices".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 - Access Control System Units.
 - 4. UL 305 - Panic Hardware.

5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 1. Manufacturers:
 - a. Pemko (PE) - EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.
 2. Manufacturers:

- a. McKinney (MK) - QC-C Series.

2.3 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
 - 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 - 2. Furnish dust proof strikes for bottom bolts.
 - 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 - 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 - 5. Manufacturers:
 - a. Rockwood (RO).
- B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 - 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 - 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 - 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 - 4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
 - 5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
 - 6. Manufacturers:
 - a. Rockwood (RO).

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 - 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 - 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 - 4. Tubular deadlocks and other auxiliary locks.
 - 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

6. Keyway: Match Facility Standard.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. Existing System: Field verify and key cylinders to match Owner's existing system.
- D. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. Key Registration List (Bitting List):
1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.6 CYLINDRICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical locksets shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and deadbolt monitoring.

- d. Two-year limited warranty on electrified functions.
- 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 10X Line.
 - b. No Substitution.

2.7 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. Exit devices shall have a five-year warranty.
 - 2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 - 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 - 4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 - 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 - 6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
 - 7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

- a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Electromechanical exit devices shall have the following functions and features:
 - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
 - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
 - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
 - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
 - e. Five-year limited warranty for electromechanical features.
 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.
 - b. No Substitution.

2.9 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Heavy duty surface mounted door closers shall have a 30-year warranty.
 2. Manufacturers:
 - a. Sargent Manufacturing (SA) - 351 Series.
 - b. No Substitution.
- C. Electromechanical Sliding Door Operators (Moderate/High Traffic): Provide low energy operators that comply with requirements for the Americans with Disabilities Act (ADA). Operators shall accommodate openings up to 400 pounds and 36" wide. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide operators with functions and features as follows:
 - a. Adjustable 0-24 second open time.
 - b. Three operation modes: auto with open-assist, hold open and lock modes.
 - c. Activation via push button, keypad or wave sensor as specified.
 - d. Customizable DIP switches for power level for lightweight or heavy doors, slam-shut functionality and beeper alerts.
 2. Manufacturers:
 - a. Pemko (PE) - PemkoMatic Series.
 - b. No Substitution.

2.10 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.11 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:
 - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 1. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Rockwood (RO).
 - c. Sargent Manufacturing (SA).

2.12 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko (PE).

2.13 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 1. Quantities listed are for each pair of doors, or for each single door.
 2. The supplier is responsible for handling and sizing all products.
 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Manufacturer's Abbreviations:
 1. MK - McKinney
 2. PE - Pemko

- 3. SU - Securitron
- 4. RO - Rockwood
- 5. SA - SARGENT
- 6. OT - Other

Hardware Sets

Set: 1.0

Doors: C146B, C156

Description: EXTERIOR ACCESS CONTROL LOCK

1 Continuous Hinge	CFMxxHD1 PT		PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Access Control Mort Lock	SN200-82271-24V LNL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
1 DPS	by security		OT
1 ElectroLynx Harness	QC-C1500P		MK
1 ElectroLynx Harness	QC-Cxxx		MK
1 Wiring Diagram	WD-SYSPK		SA

Notes: Door is normally closed and locked.

When presented with valid credentials, reader unlocks door.

During power failure or fire alarm, lock is battery powered and door remains locked (fail secure).

REX switch within lock allows free egress at all times.

Set: 2.0

Doors: C146A

Description: INTERIOR ALUMINUM DOOR W/ ACCESS CONTROL

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Electric Power Transfer	EL-CEPT	630	SU
1 Access Control Mort Lock	SN200-82271-24V LNL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Floor Stop	441CU	US26D	RO
1 Power Supply	by security		OT

1 DPS	by security	OT
1 ElectroLynx Harness	QC-C1500P	MK
1 ElectroLynx Harness	QC-Cxxx	MK
1 Wiring Diagram	WD-SYSPK	SA

Notes: Balance of weatherstripping by aluminum door manufacturer. Provide brackets and spacers as required for door closers. This lock requires a minimum 5 inch stile.

Set: 3.0

Doors: C152C, C152D

Description: INTERIOR ALUMINUM PAIR

6 Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1 Mullion	L980A	US28	SA
1 Rim Exit Device, Storeroom	16 43 8804 ETL	US32D	SA
1 Rim Exit Device, Exit Only	16 43 8810 EO	US32D	SA
4 Cylinder	match Huffman ISD standards	US32D	SA
2 Surface Closer	351 PS	EN	SA

Notes: Balance of weatherstripping by aluminum door manufacturer. Provide brackets and spacers as required for door closers.

Set: 4.0

Doors: C152E, C152F

Description: INTERIOR EXIT PAIR

6 Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1 Mullion	L980A	US28	SA
1 Rim Exit Device, Storeroom	16 43 8804 ETL	US32D	SA
1 Rim Exit Device, Exit Only	16 43 8810 EO	US32D	SA
4 Cylinder	match existing	US32D	SA
2 Surface Closer	351 PS	EN	SA
2 Kick Plate	K1050 10" x LAR	US32D	RO
1 Astragal	S772BL		PE
1 Gasketing	S88BL		PE

Set: 5.0

Doors: C150A, C150B, C152I, C152K

Description: ALUMINUM EXTERIOR PAIR W/ ACCESS CONTROL

2 Continuous Hinge	CFMxxHD1 PT		PE
2 Electric Power Transfer	EL-CEPT	630	SU
1 Mullion	L980A	US28	SA

1 Rim Exit Device, Exit Only	16 43 55 8810 EO	US32D	SA
1 Rim Exit Device	LD 43 56 SN200 8804	US32D	SA
1 Vandal Resistant Trim	826	US32D	SA
3 Cylinder	match Huffman ISD standards	US32D	SA
2 Surface Closer	351 PS	EN	SA
2 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
2 DPS	by security		OT
2 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-Cxxx		MK
1 Wiring Diagram	WD-SYSPK		SA

Notes: Door is normally closed and locked.
When presented with valid credentials, integrated reader unlocks door.
During power failure or fire alarm, door remains locked (fail secure).
REX switch within lock allows free egress at all times.

Balance of weatherstripping by aluminum door manufacturer. Provide brackets and spacers as required for door closers.

Set: 6.0

Doors: C141

Description: INTERIOR EXIT PAIR W/ ACCESS CONTROL

6 Hinge, Full Mortise, Hvy Wt	T4A3386 NRP	US32D	MK
2 Electric Power Transfer	EL-CEPT	630	SU
1 Mullion	L980A	US28	SA
1 Rim Exit Device	LD 43 56 SN200 8804 ETL	US32D	SA
1 Rim Exit Device, Exit Only	16 43 55 8810 EO	US32D	SA
3 Cylinder	match Huffman ISD Standards	US32D	SA
2 Surface Closer	351 PS	EN	SA
2 Kick Plate	K1050 10" x LAR	US32D	RO
2 Silencer	608-RKW		RO
1 Power Supply	by security		OT
2 DPS	by security		OT
2 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-Cxxx		MK
1 Wiring Diagram	WD-SYSPK		SA

Set: 7.0

Doors: C152A, C152B

Description: EXTERIOR EXIT PAIR W/ ACCESS CONTROL

2 Continuous Hinge	CFMxxHD1 PT		PE
2 Electric Power Transfer	EL-CEPT	630	SU
1 Mullion	L980A	US28	SA
1 Rim Exit Device, Exit Only	16 43 55 8810 EO	US32D	SA
1 Rim Exit Device	LD 43 56 SN200 8804	US32D	SA
1 Vandal Resistant Trim	826	US32D	SA
3 Cylinder	Match Huffman ISD Standards	US32D	SA
2 Surface Closer	351 PS	EN	SA
2 Kick Plate	K1050 10" x LAR	US32D	RO
2 Astragal	303AS		PE
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
2 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
2 DPS	by security		OT
2 ElectroLynx Harness	QC-C1500P		MK
2 ElectroLynx Harness	QC-Cxxx		MK
1 Wiring Diagram	WD-SYSPK		SA

Set: 8.0

Doors: C144

Description: EXTERIOR EXIT W/ ACCESS CONTROL

1 Continuous Hinge	CFMxxHD1 PT		PE
1 Electric Power Transfer	EL-CEPT	630	SU
1 Rim Exit Device	LD 43 56 SN200 8804	US32D	SA
1 Vandal Resistant Trim	826	US32D	SA
1 Cylinder	match Huffman ISD Standards	US32D	SA
1 Surface Closer	351 PS	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Gasketing	303AS		PE
1 Rain Guard	346C		PE
1 Sweep	315CN		PE
1 Threshold	2005AV		PE
1 Power Supply	by security		OT
1 DPS	by security		OT
1 ElectroLynx Harness	QC-C1500P		MK
1 Wiring Diagram	WD-SYSPK		SA
1 ElectroLynx Harness	QC-Cxxx		MK

Notes: Door is normally closed and locked.
When presented with valid credentials, integrated reader unlocks door.

During power failure or fire alarm, door remains locked (fail secure).
REX switch within lock allows free egress at all times.

Set: 9.0

Doors: C145B, C148B

Description: OVERHEAD DOOR

1 Cylinder	Match Huffman ISD standards	US32D	SA
1 Keyswitch	MKA		SU

Notes: Hardware by door supplier. Verify cylinder requirements, if any.

Set: 10.0

Doors: C139, C140, C145A, C147

Description: STORAGE

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Storeroom/Closet Lock	8204 LL	US26D	SA
1 Cylinder	match Huffman ISD Standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

Set: 11.0

Doors: C152G, C153

Description: STORAGE PAIR

8 Hinge, Full Mortise	TA2714	US26D	MK
1 Surface Bolt	580-12 top only	US26D	RO
1 Storeroom/Closet Lock	8204 LL	US26D	SA
1 Cylinder	match Huffman ISD standards	US32D	SA
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
2 Floor Stop	441CU	US26D	RO
2 Silencer	608-RKW		RO

Set: 12.0

Doors: C138, C148A, C149

Description: OFFICE

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Office/Entry Lock	V04 8205 LL	US26D	SA

1 Cylinder	match Huffman ISD Standards	US32D	SA
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

Set: 13.0

Doors: C142, C145C, C151

Description: LOCKER / RESTROOM

3 Hinge, Full Mortise	TA2714	US26D	MK
1 Deadbolt	486	US26D	SA
1 Cylinder	match Huffman ISD Standards	US32D	SA
1 Pull Plate	111x70C	US26D	RO
1 Push Plate	70E	US26D	RO
1 Surface Closer	351 O / P10	EN	SA
1 Kick Plate	K1050 10" x LAR	US32D	RO
1 Floor Stop	441CU	US26D	RO
3 Silencer	608-RKW		RO

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Film Overlay (F).
 - 2. Acoustical Glazing (GA).
 - 3. Insulating Glazing Units (GI).
 - 4. Laminated Glazing (GL).
 - 5. Glazing Sealants.
 - 6. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. {RSTEMP#undefined}
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM C481 - Standard Test Method for Laboratory Aging of Sandwich Constructions; 1999.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- G. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- H. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- I. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- J. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- K. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- L. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- M. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- O. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- P. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- Q. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.

- R. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.
- S. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- T. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- V. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- W. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2017.
- X. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- Y. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
- Z. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.
- AA. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.
- BB. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.4 DEFINITIONS

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C1036.
- B. Interspace: Space between lites of an insulating glass unit.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the BIBC and ASTM E1300.
 - 1. Design Wind Pressures: As indicated on Structural Drawings.
 - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Structural Drawings.
 - b. Basic Wind Speed: As indicated on Structural Drawings.
 - c. Importance Factor: As indicated on Structural Drawings.
 - 3. Exposure Category: As indicated on Structural Drawings.
 - 4. Design Snow Loads: As indicated on Structural Drawings.
 - 5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
 - 6. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 - 7. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.

- D. Windborne Debris Impact Resistance: Exterior glazing shall comply with -protection testing requirements in ASTM E1996 for when tested according to ASTM E1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
 - 1. Large Missile Test: For glazing located within 30 feet (9.1 m) of grade
 - 2. Small Missile Test: For glazing located more than 30 feet (9.1 m) above grade
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
 - 2. For laminated glass lites, properties are based on products of construction indicated.
 - 3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 - 5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.6 SUBMITTALS

- A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.
- B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.
- C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: Submit glass product certificates required by Code.
 - 1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.
- F. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
 - 1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
 - a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.
 - 2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.
- G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.

2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Building Code: Comply with applicable requirements of the IBC for glazing.
 2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - a. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials, published in the Code of Federal Regulations) and ANSI Z97.1.
 - b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
 3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
 4. Glazing Publications: Comply with published recommendations of glass product organizations
 - a. GANA: Glazing Manual.
 - b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
 - c. GANA: Laminated Glazing Reference Manual.
 - d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
 - e. AAMA: TIR A7 Sloped Glazing Guidelines.
 - f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
 - g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
 5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
 6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - a. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
 7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
 - a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
 - b. Where fully tempered float glass is indicated, provide fully tempered float glass.
- B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.
- C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.
- D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.
- E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.
- F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

- G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
- I. Install glazing in mockups specified in to match glazing systems required for Project, including glazing methods.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.
- J. Pre-Construction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
- K. Pre-Installation Conference: Conduct conference at site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.
- E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.11 WARRANTY

- A. Coated Glass Products: Written warranty signed by manufacturer in which glass manufacturer agrees to replace coated glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion
- B. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- C. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: Ten (10) years from date of Substantial Completion.
- D. Glass Film: Written warranty signed by glass film manufacturer and installer in which manufacturer and installer agree to replace glass film that crack, peel, delaminate, discolor, change appearance, or failure to meet solar criteria within specified warranty period.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Glass:
 - a. Cardinal Glass Industries: [www.https://www.cardinalcorp.com](http://www.cardinalcorp.com).
 - b. Guardian Industries: www.guardianglass.com.
 - c. Pilkington North America, a subsidiary of Nippon Sheet Glass Co., Ltd.: www.pilkington.com.
 - d. Vetrotech Saint-Gobain International AG: www.vetrotech.com.
 - e. Vitro Architectural Glass: www.vitroglazings.com.
 - 2. Glass Film:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 FABRICATORS

- A. Manufacturer-certified fabricators.

2.3 MATERIALS

- A. Clear, Annealed, Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

- B. Ultraclear, Float Glass: ASTM C1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.
- C. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
- D. Fully-Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- E. Heat Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- F. Ceramic Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in GANA Engineering Standards Manual.
- G. Reflective Coated Vision Glass: ASTM C1376.
- H. Glass Film Overlay: Translucent, dimensionally stable, cast PVC film, 2 mil (0.05 mm) minimum thickness, with pressure sensitive, clear adhesive back for adhering to glass and releasable protective backing.

2.4 FIRE RESISTANT GLAZING

- A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on positive pressure testing according to NFPA 257 or UL 9, including the hose stream test, and complying with NFPA 80. For ratings 60 minutes or greater, glazing shall meet the test requirements of ASTM E119 or UL 263.
- B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire protection rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction indicating manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 degrees F (250 degrees C) temperature rise limitation; and the fire resistance rating in minutes.
- C. Film Faced Ceramic Glazing: Clear, ceramic flat glass; 5 mm thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.

2.5 INSULATING GLAZING UNITS

- A. Insulating Glazing Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
- B. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
 - 1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum
 - 2. Desiccant: Molecular sieve or silica gel, or a blend of both.
 - 3. Performance Properties: Refer to Glazing schedule.
- C. Spandrel Glass:
 - 1. Silicone Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.
 - 2. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C1048.

2.6 LAMINATED GLAZING

- A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer, ionomeric polymer interlayer, or cast in place and cured transparent resin interlayer, as scheduled, to comply with interlayer manufacturer's written instructions.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Thickness: As required.
 4. Interlayer Color: Clear unless otherwise indicated
- B. Windborne Debris Impact Resistant Laminated Glass: Comply with requirements for laminated glass except laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions:

2.7 METAL-FACED INSULATED INFILL PANELS

- A. Metal-faced insulating panels for installation in glazing systems
1. Basis of Design: "Thermolite" Insulated Composite Panels manufactured by Laminators Incorporated.
 2. Construction: Prefinished ASTM B209/B209M aluminum sheets over a corrugated polyallomer (CPA) stabilizers on both faces with an insulating foam core
 3. Panel Facing: Smooth face, minimum 0.021 inch (0.53 mm) thick, ASTM B209/B209M aluminum sheet.
 4. Panel Backing: Random finished painted aluminum sheet, minimum 0.013 inch (0.33 mm) thick, ASTM B209/B209M aluminum sheet.
 5. Panel Thickness: 1 inch (25 mm).
 6. Panel Core: Expanded polystyrene, R-7.13 for 1" thickness. R-value increases as panel thickness increases.
 7. Fire Test Performance: ASTM E84; Class A.
 8. Bond Test Performance: ASTM C481-A Cyclic Aging: Pass.
 9. Finish: PVDF/Kynar 500 - 20-year warranty paint system meeting AAMA 2605.

2.8 GLASS FILM

- A. Performance Requirements:
1. Scratch resistant coating that, after fully cured, facilitates cleaning without damaging or scratching film.
 2. Optical Distortion: When viewed from a distance of 10 feet at angles up to 45 degrees from either side of the glass, there is no discernible distortion.
 3. Edges: Seal edges except when the film is applied with a lacquer that prevents moisture or free water from penetrating between the film and the glass.
- B. Coating: Provide coating with uniform finish, without noticeable pin holes, streaks, thin spots, scratches, or banding.
1. Light Transmission:
 - a. Maximum Variation across Width and Length: Not to exceed 1 percent.
 - b. Variation in Transmission across Width and Length: Not to exceed 2 percent.
- C. Rate of Change of Total Transmission across Width and Length: Not to exceed 1 percent in 4 inches.

2.9 GLAZING ACCESSORIES

- A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.
- B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

- C. Colors of Exposed Glazing Sealants: As selected by Architect.
- D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Pecora Corporation.
 - e. Sika Corporation.
- E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Sika Corporation.
- F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Polymeric Systems, Inc.
 - f. Schnee-Morehead, Inc., an ITW company.
 - g. Sika Corporation.
- G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Bostik, Inc.
 - c. Dow Corning Corporation.
 - d. GE Construction Sealants; Momentive Performance Materials Inc.
 - e. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - f. Pecora Corporation.
 - g. Polymeric Systems, Inc.
 - h. Schnee-Morehead, Inc., an ITW company.
 - i. Sika Corporation.
- H. Glazing Sealants for Fire-Resistance-Rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
2. Colors of Exposed Glazing Sealants: As selected by Architect.
- I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.
 1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
 2. Setting Blocks: Silicone, minimum 4 inches long and wide enough to fully support all lites of glazing unit.
 3. Spacers: Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 4. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
 5. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
 6. Perimeter Insulation for Fire Resistant Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 2. Edge and Surface Conditions: Comply with the recommendations of AAMA Structural Properties of Glass for clean cut edges, except comply with manufacturer's recommendations.
 3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.

- B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.
- C. Butt Glazing: Clean cut or flat grind vertical edges of butt glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
 - 1. Edges: Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
 - 1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
 - 2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
- B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.
- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.
- D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.
- E. Glass Film Preparation:
 - 1. Remove particulate matter on the glass surface using a scraping blade.
 - 2. Place an absorbent towel on window sill or sash to absorb moisture generated by the film application.

3.3 GLAZING

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 - 1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
 - 1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
 - 2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
 - 3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 - 4. Do not remove release paper from tape until right before each glazing unit is installed.
 - 5. Apply heel bead of elastomeric sealant.
 - 6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
 - 7. Apply cap bead of elastomeric sealant over exposed edge of tape.
- L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 - 1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 - 2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 - 3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and

- pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
4. Install gaskets to protrude past face of glazing stops.
- M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
 2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
 2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.
 3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
 4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
 5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.
- O. Glass Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying in pattern indicated on Drawings to the interior face of clean glass, according to manufacturer's written instructions, using the squeegee technique to remove moisture.
1. Cut film edges neatly and square at a uniform distance of 1/16 inch (1.5 mm) to 1/32 inch (0.75 mm) of the window sealing device. Avoid scoring glass when cutting film.
- P. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
 2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
 3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
 4. Maximum Joint Gap: 1/32 inch.

3.4 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 SCHEDULE

4.1 GLAZING SCHEDULE

- A. Film Overlay (F):
1. F1: Safety and Security Film:
 - a. Basis of Design: Scotchield Ultra S800 as manufactured by 3M.
 - 1) Thickness: 8 mil.
 - 2) Color: Clear.
 - b. Alternate acceptable products:
 - 1) Solar Gard Armor Coat, 8 mil, Clear.
 - 2) Madico Safety Shield 800
- B. Acoustical Glazing (GA):
1. GA1: Acoustical Glazing: Glass unit consisting of 1/4 inch (6 mm) clear, tempered glass laminated to 3/8 inch (9 mm) clear float glass comprised of two 3/16 inch (4.5 mm) clear float glass lites laminated to each other with clear 0.060 inch thick polyvinyl butyral (PVB) interlayer.
- C. Insulating Glazing Units (GI):
1. General
 - a. Minimum Performance Requirements per ICC (IECC):
 - 1) U-Factor: 0.50 (maximum).
 - 2) Solar Heat Gain Coefficient: 0.25 (maximum).
 2. Type GI1:
 - a. Basis of Design: SunGuard SNX 51/23 manufactured by Guardian Advanced Architectural Glass.
 - b. Assembly:
 - 1) Exterior Lite:
 - (a) Thickness: 1/4 inch (6 mm).
 - (b) Color:
 - (c) Coatings:
 - 2) Gap:
 - (a) Thickness: 1/2 inch (13 mm)
 - (b) Gas: Air.
 - 3) Interior Lite:
 - (a) Thickness: 1/4 inch (6 mm).
 - (b) Color: Clear.
 - (c) Coatings: None.
 - c. Performance:
 - 1) Visible Transmittance (%): 51.
 - 2) Winter Night-time U-value: 0.29 (air).
 - 3) Shading Coefficient: 0.27.
 - 4) Solar Heat Gain Coefficient: 0.23.
 - 5) Light to Solar Gain Ratio (LSG): 2.18.
 3. Type GI2:
 - a. Basis of Design: SunGuard SNX 51/23 manufactured by Guardian Advanced Architectural Glass.
 - b. Assembly:
 - 1) Exterior Lite:
 - (a) Thickness: 1/4 inch (6 mm).

- 2) Gap:
 - (a) Thickness: 1/2 inch (13 mm)
 - (b) Gas: Air.
- 3) Interior Lite:
 - (a) Thickness: 1/4 inch (6 mm).
 - (b) Color: Clear.
 - (c) Coatings: None.
- 4) Film:
 - (a) F-1.
- c. Performance:
 - 1) Visible Transmittance (%): 51.
 - 2) Winter Night-time U-value: 0.29 (air).
 - 3) Shading Coefficient: 0.27.
 - 4) Solar Heat Gain Coefficient: 0.23.
 - 5) Light to Solar Gain Ratio (LSG): 2.18.
- D. Laminated Safety Glazing GL1
 - 1. Two layers of 1/4" thick glazing quality, clear, tempered float glass with Film F-1 laminated between.
- E. Tempered Glazing GT1
 - 1. 1/4" thick glazing quality, clear, tempered float glass

END OF SECTION 08 80 00

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SECTION 08 83 00 - MIRRORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Glass Mirrors.
 - a. Annealed Float Glass.
- B. Related Sections:

1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
- H. GANA (GM) - GANA Glazing Manual; 2022.
- I. GANA (SM) - GANA Sealant Manual; 2008.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples, 3 x 3 inch (75 x 75 mm) in size, illustrating mirrors design, edging, and coloration.
- E. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Mirror Glazing: One of each type and size.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
 - 1. Maintain one copy on project site.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.6 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Mirrors:
 - a. Binswanger Mirror/ACI Distribution: www.binswangerglass.com.
 - b. GGI - General Glass International: www.generalglass.com.
 - c. Lenoir Mirror Co.: www.lenoirmirror.com.
 - d. Trulite Glass and Aluminum Solutions: www.trulite.com.
 - e. Walker Glass Company Ltd.: www.walkerglass.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.
 - 1. Thickness: 1/4 inch (6.4 mm).
 - 2. Edges: Arrised.
 - 3. Size: As indicated on Drawings.

2.3 ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.
- C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.
- D. Glazing Clips: Manufacturer's standard type.
- E. Mirror Attachment Accessories: Stainless steel clips.
- F. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
 - 1. Application Temperature: Minus 35 to 140 degrees F (Minus 37 to 60 degrees C) at contact surfaces.
 - 2. Volatile Organic Content (VOC): Less than 7 percent by weight.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

- B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
- C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.4 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

END OF SECTION 08 83 00

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SECTION 08 87 23 - SAFETY AND SECURITY FILMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Glazing film applied to existing and new glazing assemblies.
 - 2. New Glazing: Factory or shop install film to glazing before installation in frames.
- B. Related Requirements:
 - 1. Section 08 11 13 - Hollow Metal Doors and Frames: New doors with glazing to receive film.
 - 2. Section 08 51 13 - Aluminum Windows: New windows to receive film.
 - 3. Section 08 80 00 - Glazing: New glazing to received film.

1.3 ABBREVIATIONS AND ACRONYMS

- A. CFR - Code of Federal Regulations.
- B. GSA - General Services Administration.

1.4 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2023.
- D. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.
- E. ASTM D1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics; 2021.
- F. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Detailing installation of film, anchoring accessories, and sealant.
- C. Samples: For each film product to be used, minimum size 4 inches (102 mm) by 6 inches (152 mm), representing actual product, color, and patterns.
- D. Samples, Supplemental Anchors: Where supplemental anchors are necessary to achieve specified performance submit detailed information in accordance with substitution procedures; include two samples, minimum length 2 inches (51 mm).
- E. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.
- F. Specimen Warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of safety glazing films with minimum 10 years successful experience.

- B. Installer Qualifications: Certified by glazing film manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.8 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. 3M Window Film.
 - 2. Armored One, LLC.
 - 3. Avery Dennison.
 - 4. Flexvue Films.
 - 5. Madico, Inc.
 - 6. XPEL, Inc.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 SAFETY AND SECURITY GLAZING FILM

- A. Safety Glazing: Retrofit existing glazing assemblies to provide impact resistance complying with ANSI Z97.1 and 16 CFR 1201, Category II.
 - 1. 1/4 inch (6 mm) thick clear annealed glass.
 - 2. Surface applied film.
 - 3. Requiring no supplemental anchoring devices.
- B. Retrofit existing glazing assemblies to provide impact resistance and forced attack resistance complying with FTD-SA-C1, ANSI Z97.1, and CPSC 16 CFR 1201 Category II.

2.3 MATERIALS

- A. Glazing Film: Transparent polyester film for permanent bonding to glass.
 - 1. Thickness: 0.008 inch (0.2 mm), minimum.
 - 2. Color: Clear.
- B. Forced Attack Resistant Glazing Film:
 - 1. Transparent polyester film for permanent bonding to glass.
 - 2. Thickness: 0.023 inches (23 mil), minimum.
 - a. Installing multiple layers of thinner film to accomplish the required thickness is not allowed.
 - 3. Adhesive Type: Pressure sensitive.
 - 4. FTD SA – Standard for Shooter Attack certification, Class 1 (tested on 1/4" tempered glass).

5. Tensile Strength: 35,000 psi minimum when tested in accordance with ASTM D882.
6. Breaking Strength: 640 lbs. / inch when tested in accordance with ASTM D882.
7. Elongation at Break: 230% when tested in accordance with ASTM D882.
8. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
9. Light Transmission of Film Applied on 1/4 inch (6 mm) Thick Clear Annealed Glass:
 - a. Haze: ASTM D1003, <4%.
 - b. Color b: ASTM D2244, 4.2.
 - c. Visible Light Transmittance: 87%.
 - d. Visible Light Reflectance (Int): 12%.
 - e. Visible Light Reflectance (Ext): 12%.
 - f. Ultra Violet Light Transmittance: 1 percent, maximum.
10. Solar Energy:
 - a. Total Solar Energy Reflected: 11%.
 - b. Total Solar Energy Transmitted: 77%.
 - c. Total Solar Energy Absorbed: 12%.
 - d. Shading Coefficient: 0.93.
 - e. Total Solar Energy Rejected: 19%.
 - f. Solar Heat Gain Coefficient: 0.81.
 - g. U-Value Winter: 1.03.
 - h. K-Value Winter: 5.85.
 - i. Glare Reduction: 3%.
11. Anchoring:
 - C. Accessory Materials: As recommended or required by film manufacturer.
 - D. Structural Silicone Sealant: Self-priming, elastomeric adhesive complying with ASTM C1184.
 - E. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Field -Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
- B. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.
- C. Verify glass is not cracked, chipped, broken, or damaged.
- D. Verify that frames are securely anchored and free of defects.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- C. Protect adjacent surfaces.
- D. Do not begin installation until substrates have been properly prepared.

3.3 INSTALLATION

- A. Do not apply glazing film when surface temperature is less than 40 degrees F (4 degrees C) or if precipitation is imminent.

- B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- C. Accurately cut film with straight edges to required sizes allowing 1/16 inch (2 mm) to 1/8 inch (3 mm) gap at perimeter of glazed panel unless otherwise required by anchorage method.
- D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.
- E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
- F. Remove labels and protective covers.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 08 87 23

SECTION 08 91 19 - FIXED LOUVERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Fixed, extruded aluminum and formed metal louvers.
 - 2. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- D. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- F. {RSTEMP#undefined}
- G. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- K. {RSTEMP#undefined}
- L. {RSTEMP#1253}
- M. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. Drainable Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind Driven Rain Resistant Louver: Louver that provides specified wind driven rain performance determined by testing according to AMCA 500-L.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings:
 - 1. For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing:
 - a. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - b. Show mullion profiles and locations.
 - c. Windstorm: Design loads as indicated on drawings.
- C. Samples: Submit for units with factory applied color finishes.

1.6 QUALITY ASSURANCE

- A. Delegated Design Submittal: For louvers indicated to comply with structural and seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- C. Windborne debris impact resistance test reports.
- D. Regulatory Requirements:
 - 1. SMACNA Standard: Comply with recommendations in SMACNA (ASMM) Architectural Sheet Metal Manual for fabrication, construction details, and installation procedures.
 - 2. Welding - Qualify procedures and personnel according to the following:
 - a. {RS#1253} Structural Welding Code - Aluminum.
- E. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory applied color finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Louvers:
 - a. Airolite Company, LLC (The): www.airolite.com.
 - b. Arrow United Industries: www.arrowunited.com.
 - c. Construction Specialties, Inc.: www.c-sgroup.com.
 - d. Greenheck Fan Corporation: www.greenheck.com.
 - e. Ruskin Company: www.ruskin.com.
 - 2. Glazing System Adapter:
 - a. Greenheck Fan Corporation: www.greenheck.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B221/ASTM B221M , Alloy 6063-T5, T-52, or T6.

- B. Aluminum Sheet: ASTM B209/B209M, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) zinc coating, mill phosphatized.
- D. Stainless Steel Sheet: ASTM A240/A240M, Type 304, No. 4 finish, with grain running parallel to length of blades and frame members..
- E. Fasteners - Use types and sizes to suit unit installation conditions:
 - 1. Use tamper resistant screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For fastening galvanized steel, use hot dip galvanized steel or 300 series stainless steel fasteners.
 - 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - 5. For color finished louvers, use fasteners with heads that match color of louvers.
- F. Post installed Fasteners for Concrete and Masonry: Torque controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.3 FIXED, EXTRUDED ALUMINUM LOUVERS

- A. Horizontal Continuous Line, Drainable Blade Louver: Drainable blade louver with blade gutters (drains) in rear two-thirds of blades only and with semirecessed mullions capable of collecting and draining water from blades:
 - 1. Basis of Design Product(s):
 - a. Products manufactured by Airolite Company, LLC (The).
 - b. Products manufactured by Arrow United Industries.
 - c. Products manufactured by Construction Specialties, Inc.
 - d. Products manufactured by Greenheck Fan Corporation.
 - e. Products manufactured by Ruskin Company; Tomkins PLC.
 - 2. Louver Depth: 6 inches (150 mm).
 - 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
 - 4. Louver Performance Ratings:
 - a. Free Area: Not less than 7.8 sq. ft. (0.72 sq. m) for 48 by 48 inches (1220 by 1220 mm) louver.
 - b. Point of Beginning Water Penetration: Not less than 850 fpm (4.3 m/s).
 - c. Air Performance: Not more than 0.10 in. wg (25 Pa) static pressure drop at 800 fpm (4.1 m/s) free area exhaust velocity.

2.4 LOUVER SCREENS

- A. Provide screen at each exterior louver:
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Insect screening.
- B. Secure screen frames to louver frames with stainless steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.
- C. Louver Screen Frames:
 - 1. Metal: Aluminum. Reinforce extruded aluminum screen frames at corners with clips.
 - 2. Fabricate with mitered corners to louver sizes indicated.
 - 3. Finish: Same finish as louver frames to which louver screens are attached.
 - 4. Type: Rewirable frames with a driven spline or insert.

2.5 GLAZING SYSTEM ADAPTER

- A. Description: Extruded aluminum adapter for mounting louvers in glazing systems.

- B. Basis of Design:
 - 1. Glazing Adapter manufactured by Greenheck Fan Corporation.
- C. Material: 0.081 inch (2 mm) thick 6063-T5 extruded aluminum.
- D. Finish: Kynar.
- E. Size: As required.

2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies:
 - 1. Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field bolted assembly with close fitting joints in jambs and mullions, reinforced with splice plates:
 - a. Continuous Vertical Assemblies: Fabricate units without interrupting blade spacing pattern unless horizontal mullions are indicated.
 - b. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less:
 - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close fitting blade splices designed to permit expansion and contraction.
 - 2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 - 3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
 - 4. Exterior Corners: Prefabricated corner units with mitered blades with concealed close fitting splices and with fully recessed mullions at corners.
- G. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 FINISHES

- A. Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.
- B. Aluminum Finishes:
 - 1. Finish louvers after assembly.
 - 2. Baked Enamel or Powder Coat Finish:

- a. AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish:
 - 1) Color and Gloss: Selected by the Architect.
 3. High Performance Organic Finish:
 - a. Two coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions:
 - 1) Color and Gloss: Selected by the Architect.
- C. Galvanized Steel Sheet Finishes:
 1. Finish louvers after assembly.
 2. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A780/A780M.
 3. Baked Enamel or Powder Coat Finish:
 - a. Immediately after cleaning and pretreating, apply two coat, baked on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 2 mils (0.05 mm):
 - 1) Color and Gloss: Selected by the Architect.
- D. Stainless Steel Sheet Finishes: Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

3.2 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.3 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.4 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 92 00 - Joint Sealants for sealants applied during louver installation.

3.5 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged units and replace with new units:
 - 1. Touch up minor abrasions in finishes with air dried coating that matches color and gloss of, and is compatible with, factory applied finish coating.

END OF SECTION 08 91 19

SECTION 09 05 00 - COMMON WORK RESULTS FOR FINISHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Substrate testing.
 - 2. Waterproof membranes.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete design, underslab vapor barrier and finished concrete surface required to accept flooring adhesive and finish flooring system.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- C. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007 - Not Active.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- F. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- G. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- H. ASTM F1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring; 2021.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- K. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Adhesives.
 - 2. Leadership in Energy and Environmental Design (LEED).
 - 3. Volatile Organic Compound (VOC)

1.5 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's printed descriptions of materials, components and systems; performance criteria; use limitations; preparation instructions and recommendations; storage and handling requirements and recommendations; and installation methods.

- B. Certificates:
 - 1. Submit with manufacturer's signature certifying that each product and/or system meets the requirements of the performance characteristics, physical criteria, and applicable standards specified.
 - a. Provide Master Grade Certificate as specified in ANSI A137.1.
- C. Test and Evaluation Reports:
 - 1. Submit certified test results by a recognized testing laboratory in accordance with specified test methods for each product and/or system indicating physical, chemical and performance characteristics.
- D. Samples:
 - 1. Submit samples showing full range of color and texture variations expected.
 - 2. Full size units of each type and composition of tile and for each color and finish required.
 - 3. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 4. Waterproof membrane in 6 inch by 6 inch (150 mm by 150 mm) sample.
 - 5. Thresholds in 6 inch (150 mm) lengths.
- E. Closeout Submittals:
 - 1. Operation and Maintenance Data: Including, but not limited to, methods for maintaining installed products and precautions against cleaning materials with methods detrimental to finishes and performance.
 - 2. Executed Warranty Documentation: Manufacturers' material warranties and installers workmanship warranty.
 - 3. Record Documents: Drawings, Specifications, Product Data.

1.6 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
- B. Static Coefficient of Friction (SCOF): For tile installed on walkway surfaces which are not anticipated to be wet, provide products with values determined by testing identical products per ASTM C1028:
 - 1. Level Surfaces: Minimum 0.6.
 - 2. Ramp Surfaces: Minimum 0.8.
- C. Dynamic Coefficient of Friction (DCOF): Per ANSI A137.1 Section 9.6 DCOF AcuTest:
 - 1. Wet Level Surfaces: Minimum 0.42 unless noted otherwise.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Surface Burning Characteristics: ASTM E84; identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 - 2. Accessibility Requirements: Comply with applicable requirements.
 - a. ADA Standards.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
- B. Qualifications:
 - 1. Installer / Applicator: Perform installation with skilled, experienced and trained workmen supervised by trained personnel who shall have a minimum three (3) years successful experience in installations of similar size and scope.

2. Testing Agency: An independent testing agency with the experience and capability to conduct the testing indicated, meeting requirements of ISO/IEC 17025 or ASTM E329 and ASTM E699.
- C. Source Limitations:
 1. Obtain spray-applied adhesive through one source from a single manufacturer.
 2. Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 3. Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
 - a. Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
 - 1) Waterproofing.
 - 2) Joint sealants.
 - 3) Cementitious backer units.
 - 4) Metal edge strips.
- D. Sustainability Standards and Certifications:
 1. Adhesive and Sealant VOC Limits: According to South Coast Air Quality Management District Rule 1168 and GS-36 for aerosols.
 2. VOC Limits: As tested using U.S. EPA Reference Test Method 24 and as defined by
 - a. South Coast Air Quality Management District Rules: In areas where exposure to freeze/thaw conditions and direct exposure to moisture will not occur.
 - 1) SCAQMD Rule 1168, Adhesive and Sealant Applications
 - b. California Air Resources Board: For areas where freeze/thaw conditions do exist or direct exposure to moisture can occur.
 - 1) CARB for containers 16 oz. or less.
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Handling per manufacturer's recommendations, Section 01 60 00 - Product Requirements, and as follows:
 1. Delivery and Acceptance Requirements
 - a. Deliver materials to Project site in an undamaged condition, in original, unopened and undamaged packages or containers bearing manufacturer's intact label, names, brand names, types and thicknesses of contents, and proper handling, storing, unpacking, protecting, and installation instructions, as warranted.
 - 1) Comply with requirements in ANSI A137.1 for labeling tile packages.
 - b. Inspect shipped materials on delivery to ensure compliance with requirements of Contract Documents and to ensure that products are undamaged and properly protected. Reject damaged goods and accept properly ordered, protected and undamaged goods.
 2. Storage and Handling Requirements
 - a. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.

- b. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.
 - c. Store adhesive materials in a dry, temperature-controlled interior area at 65-80 deg F (18-27 deg C). Protect materials from damage from improper handling, exposure to temperature extremes, and the action of other trades.
- 3. Packaging Waste Management
 - a. Request in writing that manufacturers, fabricators, suppliers and shippers provide least amount of packaging that adequately and properly protects, supports and contains the items shipped, and is reusable, returnable or recyclable.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.10 EXTRA STOCK

- A. Refer to related sections for extra stock requirements.

1.11 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 - Project Management and Coordination.

1.12 WARRANTY

- A. Refer to related sections for specific product warranty requirements.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Conditions and Measurements: Visit jobsite to verify installation conditions and floor measurements.
- B. Ambient Conditions per manufacturer's written recommendations, and as follows:
 - 1. New concrete slabs shall be flat, clean and dry meeting all moisture tests passing manufacturer's written requirements.
 - 2. Environmental Limitations: Maintain temperature and relative humidity per manufacturer's recommendations.
 - a. Maintain space, substrate temperatures, and RH for time prior to, during and after installation as recommended.
 - 3. Acclimate floor finish materials into spaces they will be installed a minimum 48 hours in advance of installation.
 - a. Do not install until all floor finish materials are same temperature as space where they are to be installed.

3.2 EXAMINATION - GENERAL

- A. Contractor shall examine preparatory work by others, with Installer/Applicator present, for compliance with requirements affecting Work performance.

1. Contractor shall notify Architect of any issues which would affect installation of finish. Absence of such notification shall constitute acceptance of responsibility by Contractor.
- B. Verify that field measurements, surfaces, substrates, structural support, tolerances, levelness, plumbness, temperature, humidity, moisture content level, cleanliness, and other conditions are as required by the manufacturer, and ready to receive Work.

3.3 EXAMINATION - FLOORING

- A. Verify that concrete floors to receive resilient flooring meet ASTM F710 requirements and are flat as recommended by floor finish manufacturer.
- B. Verify that wood and panel type underlayment substrates to receive resilient flooring meet ASTM F1482 requirements and are flat as recommended by floor finish manufacturer.
- C. Test substrates as required by manufacturer to verify proper conditions.
 1. Portland-Cement Concrete:
 - a. Perform moisture testing to verify that concrete substrate is sound and dry. Both of the following tests are required:
 - 1) Perform relative humidity (RH) test using in situ probes per ASTM F2170 . Proceed with installation only after each substrate measures a maximum 75 percent RH.
 - 2) Perform anhydrous calcium chloride testing per ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 7 lbs of water/1000 sf (3.18 kg of water/92.9m2) in 24 hours.
 - b. Perform alkalinity testing to verify pH level is 11 or below per ASTM F710.
 - c. Perform bond testing per ASTM F710 to determine compatibility of adhesive to concrete substrate.
 2. Wood Underlayment: Shall be dry, clean, structurally sound, well nailed and/or glued, free of voids and with joints that do not exceed 1/16 inch (1.6mm) per floor finish manufacturer's installation instructions.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.
 - a. Commencement of work related to this Section will constitute acceptance of conditions.

3.4 INSTALLATION - GENERAL

- A. Lay out tiling so that no tile is cut to less than 1/2 of its full size in either direction.
- B. Slope tile within 3 foot diameter of a floor drain, unless otherwise noted.
- C. Form internal angles square.

3.5 INSTALLATION - STONE THRESHOLDS

- A. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:
 1. Inspect floor finish system installation for non-conforming Work including, but not limited to, the following:
 - a. Lack of adequate adhesion.
 - b. Adhesive overspray.
 - 1) Clean off water-based adhesive overspray with a damp cloth.
 - c. Improper substrate preparation as indicated by:
 - 1) Air blisters.
 - 2) Buckling.
 - 3) Cracks.

3.7 CLEANING

- A. Clean finishes as required and in accordance with manufacturer's recommendations.

3.8 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures.

END OF SECTION 09 05 00

SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - a. Resilient tile and sheet.
 - b. Broadloom carpet.
 - c. Carpet tile.
 - d. Thin-set tile.
 - 2. Preparation of new and existing concrete floor slabs for installation of floor coverings.
 - 3. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - a. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
 - 4. Remedial floor coatings.
 - 5. Remedial floor sheet membrane.
 - 6. Crack isolation membrane.
- B. Related Sections:
 - 1. Section 02 41 00 - Demolition: Removal of existing flooring.

1.3 REFERENCE STANDARDS

- A. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Adhesives.
 - 2. Leadership in Energy and Environmental Design (LEED).
 - 3. Volatile Organic Compound (VOC).

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.6 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.

- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 - 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 4. Manufacturer's installation instructions.
 - 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- C. Adhesive Bond and Compatibility Test Report.
- D. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.

1.7 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 03 54 00 - Cast Underlayment.
 - 3. Section 06 10 00 - Rough Carpentry: Sub-flooring.
 - 4. Section 09 68 00 - Carpeting.

1.8 QUALITY ASSURANCE

- A. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
 - 2. Acceptable Testing Agencies:
 - a. Independent Floor Testing & Inspection, Inc. (IFTI): www.ifti.com/#sle.
 - b. Other testing agency approved by Owner.
 - c. Substitutions: Not permitted.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Owner when specified ambient conditions have been achieved and when testing will start.
 - 6. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.

- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.10 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

1.11 WARRANTY

- A. Provide Flooring Adhesive Manufacturer's:
 - 1. Material and Workmanship Warranty:
 - a. Aerosol (22oz, 18oz) Flooring Adhesive shall be free from defects in material and workmanship for a period of two (2) years from date of manufacture when handled, stored and transported per adhesive manufacturer's requirements.
 - 2. Delamination Warranty that there shall be no delamination failure:
 - a. Due to adhesive failure for a period of five (5) years from date of installation when applied to adhere approved flooring materials per Adhesive manufacturer's requirements.
 - b. As long as moisture vapor emissions do not exceed 85 percent RH when tested in accordance with ASTM F2170.
 - c. For moisture in concrete slab conditions up to 7 lb per 1,000 sf per 24 hours when tested with a prepackaged calcium chloride crystal kit performed in accordance with ASTM F1869.
 - d. For concrete slab conditions up to a pH of 11 when tested in accordance with ASTM F710 .

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Patching Compund: Refer to Section 03 54 00 - Cast Underlayment
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Spray-Applied Adhesive:
 - 1. Water-based pressure-sensitive aerosol adhesive, VOC- Free, non-flammable, and non-HAP, emitting no dangerous fumes or odors.
 - 2. Manufacturers:
 - a. Spray-Lock by Interlock Industries, Inc., (706) 517-8989.
 - 3. Basis of Design Product(s):
 - a. Spray-Lock™ 6500 for adhering vinyl backed carpet tile, and luxury vinyl tiles (LVT) or planks.
 - b. Spray-Lock™ 9500 for adhering vinyl composition tile (VCT).

- c. Spray-Lock™ 3500 for adhering resilient sheet vinyl flooring; and formulated for use in Medical / Health Care applications.
- D. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Use product recommended by testing agency.
 3. Basis of Design:
 - a. Crown Polymers, a division of American Polymers Corporation; CrownShield 8303 MVB: www.crownpolymers.com/#sle.
 - b. H.B. Fuller Construction Products, Inc; TEC LiquiDam with TEC Level Set 200 SLU: www.tecspecialty.com/#sle.
 - c. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
 - d. Tnemec Company, Inc; Series 208 Epoxoprime MVT: www.tnemec.com/#sle.
 - e. UZIN UTZ NORTH AMERICA, INC; UZIN PE 460 with UZIN PE 280 and UZIN NC 170 LevelStar: us.uzin.com/#sle.
- E. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: 28 mil (0.028 inch) (0.711 mm).
 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.
 3. Basis of Design:
 - a. GCP Applied Technologies; Kovara MBX: www.gcpat.com/#sle.
- F. Crack Isolation Membrane:
 1. Description:
 - a. Sheet membrane used to eliminate transmission of substrate cracks
 2. Products and Manufacturers:
 - a. Sheet Membranes:
 - 1) Crack Buster Pro manufactured by Custom Building Products, a Quikrete Company.
 - 2) Dalseal CIS manufactured by Dal-Tile.
 - 3) Fracture Ban manufactured by Laticrete.
 - 4) Mapeguard 2 manufactured by Mapei.
 - 5) Nobleseal CIS manufactured by The Noble Company.
 - 6) Tileguard manufactured by Polyguard Products, Inc.
 - b. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
 - 1) Blue 92 manufactured by Laticrete International, Inc.
 - 2) Fracturefree manufactured by Custom Building Products.
 - 3) Mapelastic CI manufactured by Mapei.
 - 4) Hydro-rite FS manufactured by Texrite.

PART 3 EXECUTION

3.1 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:

1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering in accordance with Section 02 41 00 - Demolition.
 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not attempt to remove coating or penetrating material.
 - b. Do not abrade surface.
 3. Preliminary cleaning.
 4. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
 5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 7. Specified remediation, if required.
 8. Patching, smoothing, and leveling, as required.
 9. Other preparation specified.
 10. Adhesive bond and compatibility test.
 11. Protection.
- C. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.3 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

3.4 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.5 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
 - 3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.6 PREPARATION

- A. Refer to individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.9 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

3.10 APPLICATION OF SPRAY-APPLIED ADHESIVE

- A. Installation per each floor finish assembly product manufacturer's written instructions, and as follows:

1. Spray-Applied Adhesive Method:
 - a. Do not place finish-flooring product until adhesive applied to substrate is ready to receive it per adhesive manufacturer's instructions.
 - b. Mark floor equivalent to manufacturer's recommended area for size of container used. Apply no more or less adhesive than what manufacturer recommends.
 - c. Outline perimeter of the room with a 4-5 inch (100-125 mm) wide band of adhesive. Apply the adhesive from 8-12 inches (200-300 mm) above the substrate.
 - d. Lay flooring finish material, adjust and reset until layout placement is certain.
 - e. Following installation of finish flooring (typically within an hour after installing) roll entire floor area with a 75 to 100 lb (34 to 45 kg) roller to ensure proper bonding with instant shear strength.
2. Close space to traffic for 2 hours before beginning installation, however, flooring is immediately available after rolling for all range of use.

3.11 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION 09 05 61

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gypsum board.
 - 2. Partition framing systems.
 - 3. Exterior gypsum board for ceilings and soffits.
 - 4. Tile backing panels.
 - 5. Ceiling suspension systems.
 - 6. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 06 10 00 - Rough Carpentry: Building blocking.
 - 3. Section 07 92 00 - Joint Sealants: Acoustical joint sealant.

1.3 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- H. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- K. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.
- L. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.
- M. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- N. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.

- O. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- P. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 2017.
- Q. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2021.
- R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- S. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2019.
- T. ASTM C1766 - Standard Specification for Factory-Laminated Gypsum Panel Products; 2015 Edition, February 1, 2015.
- U. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- V. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; 2009 Edition, March 1, 2009
- W. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- X. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- Y. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
 - 1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
 - 2. Ground Floor Lobbies: 1/120 at 15 psf.
 - 3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
 - 4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
 - 5. Typical Partitions: 1/240 at 5 psf.
 - 6. Other Partitions: 1/240 at 5 psf.
 - a. Maximum Deflection:
 - 1) L/240 at 5 lbf per sq. ft.
 - 2) L/120 at 5 lbf per sq. ft.
 - 3) L/120 at 7.5 lbf per sq. ft.
 - 4) L/120 at 10 lbf per sq. ft.
- B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

1.5 SUBMITTALS

- A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer's load tables.
- B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of work.

- C. Samples:
 - 1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
 - 2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for work.
- D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.
- E. Evaluation Reports: ICC-ES reports for dimpled steel studs and runners and firestop tracks.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with applicable requirements of building code for interior finishes.
- B. Single Source Responsibility:
 - 1. Framing Members: Obtain steel framing members from single manufacturer.
 - 2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
 - 3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
 - 1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.
- B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.
- D. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Steel Studs and Tracks:
 - a. CEMCO: www.cemcosteel.com.
 - b. ClarkDietrich: www.clarkdietrich.com.

- c. Custom Stud, Inc.: www.customsteelcraft.com.
- d. MBA Building Supplies: www.mbastuds.com.
- e. MRI Steel Framing, LLC: www.mristeel framing.com.
- f. Phillips Manufacturing Co.: www.phillipsmfg.com.
- g. Steel Network, Inc. (The): www.steelnetwork.com.
- h. Telling Industries: www.tellingindustries.com.
- 2. Gypsum Board:
 - a. Certainteed Corporation: www.certainteed.com.
 - b. Georgia Pacific: www.gp.com.
 - c. National Gypsum Company: www.nationalgypsum.com.
 - d. USG Corporation: www.usg.com.
- 3. Tile Backer Board:
 - a. USG Corporation: www.usg.com.
- 4. Glass Mat Gypsum Sheathing Board:
 - a. USG Corporation: www.usg.com.
- 5. Cementitious Board:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - b. National Gypsum Company: www.nationalgypsum.com.
 - c. USG Corporation: www.usg.com.
- 6. Trim:
 - a. Fry Reglet Corporation: www.fryreglet.com.
 - b. Schluter Systems: www.schluter.com.
 - c. Waterguard USA: www.waterguard-usa.com.
- 7. Extruded Partition Closure:
 - a. Gordon, Inc.: www.gordon-inc.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Framing Members: ASTM C754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for metal.
 - 2. Protective Coating:
 - a. Standard: ASTM A653/A653M, G40, hot dip galvanized.
- B. Steel Framing Components: ASTM C754 for conditions indicated; hot dip galvanize complying with ASTM A653/A653M Z180.
 - 1. Steel Studs and Runners: ASTM C645, 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
 - 2. Dimpled Steel Studs and Runners: ASTM C645, equivalent to minimum base metal thickness indicated on Drawings for depth indicated on Drawings.
 - 3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 - 4. Cold-Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges; depth indicated on Drawings.
 - 5. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
 - 6. Hat Shaped, Rigid Furring Channels: ASTM C645; 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.

7. Resilient Furring Channels: 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.
 8. Cold Rolled Furring Channels 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges.
 - a. Depth: As indicated on Drawings.
 - b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
 - c. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
 9. Z-Shaped Furring Channels: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
 10. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 11. Slip Type Head Joints: Where indicated, provide one of the following:
 - a. Single Long Leg Runner System: ASTM C645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 - b. Double Runner System: ASTM C645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 3) Superior Metal Trim; Superior Flex Track System (SFT).
- C. Gypsum Board: ASTM C1396/C1396M, applicable to type of gypsum board indicated and whichever is more stringent.
1. Wall Board:
 - a. Type: X.
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Long Edges: Tapered and featured (rounded or beveled) for pre-filling.
 2. Ceiling Board: Manufactured for sag resistance
 - a. Type: X typical, C at fire-resistance-rated ceiling assemblies.
 - b. Thickness: 1/2 inch (13 mm).
 - c. Long Edges: Tapered.
 3. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces.
 - a. Type: X.
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Long Edges: Tapered.
 4. Shaft Liner Type:
 - a. Type: X.
 - b. Thickness: 1 inch (25.4 mm).
 5. Fire-Resistant Core, Foil-Backed: ASTM C1396/C1396M
 - a. Basis of Design: Gold Bond® Foil Back Gypsum Board manufactured by National Gypsum Company.
 - b. Thickness: 5/8 inch (15.9 mm).

- c. Core: Type X.
 - d. Edges: Tapered.
- D. Impact Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
 - 1. Core and Thickness: 5/8 inch (15.9 mm), Type X.
 - 2. Surface Abrasion: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 - 3. Indentation: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 - 4. Soft Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 - 5. Hard Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements according to test in Annex A1.
 - 6. Long Edges: Tapered.
 - 7. Mold Resistance: ASTM D3273, score of 10 as rated according to STM D3274.
- E. Acoustically Enhanced Gypsum Board: ASTM C1766. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
 - 1. Manufacturers: Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. CertainTeed Corp.; Silent FX QC.
 - b. National Gypsum Company; Sound Break.
 - c. PABCO; QuietRock.
 - d. G-P/Temple Inland; Comfort Guard Sound.
 - 2. Core: Regular Type.
 - 3. Long Edges: Tapered.
- F. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C1178/C1178M, standard edges. Cellulose fiber reinforced panels may be used in lieu of cementitious board.
 - 1. Core and Thickness: 5/8 inch (15.9 mm) to match conditions, Type X.
 - 2. Long Edge: Tapered.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- G. Glass Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with standard edges.
 - 1. Core: Type X.
 - 2. Thickness: 5/8 inch (15.9 mm).
 - 3. Size: 48 inches by 96 inches (1219 mm by 2438 mm).
 - 4. Long Edges: Tapered
- H. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325.
 - 1. Thickness: 1/2 inch (12.7 mm) and 5/8 inch (15.9 mm) to match conditions.
 - 2. Long Edges: Standard.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.3 BEADS, JOINT ACCESSORIES, AND OTHER TRIM

- A. Exterior Trim: ASTM C1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
 - 1. Shapes:
 - a. Cornerbead.
 - b. LC Bead: J shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.
- B. Interior Trim: ASTM C1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.
 - 1. Shapes:

- a. Cornerbead.
 - b. Bullnose bead.
 - c. LC Bead: J shaped; exposed long flange receives joint compound.
 - d. L Bead: L shaped; exposed long flange receives joint compound.
 - e. U Bead: J shaped; exposed short flange does not receive joint compound.
- 2. Flush Transition Molding:
 - a. Description: Metal trim for transition between gypsum board and suspended ceilings.
 - b. Basis of Design:
 - 1) 7904 manufactured by Armstrong World Industries, Inc.
 - c. Exposed Flange Size: 15/16 inch (24 mm).
 - d. Protective Film: Provide.
 - e. Color: As indicated on Drawings.
- C. Expansion (Control) Joint.
 - 1. Manufacturers: Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
- D. Decorative Metal Trims and Reveals: Refer to Section 05 75 00 - Decorative Formed Metal.
- E. Continuous Corner Bead: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer.
 - 1. Manufacturer: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. Fry Reglet Corporation.
 - b. Pittcon Industries.
 - c. Schluter Systems.
 - 2. Basis of Design Product: Pittcon Softforms SO-HSE-90
- F. Joint Treatment: ASTM C475/C475M.
 - 1. Joint Tape:
 - a. Exterior Gypsum Soffit Board: Paper.
 - b. Joint Compound for Exterior Applications, Glass Mat Gypsum Sheathing Board: Recommended by sheathing board manufacturer.
 - c. Joint Tape, Interior Gypsum Board: Paper.
 - 2. Joint Compound:
 - a. Gypsum Board: Pre-Filling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
 - 1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
 - (a) Use setting type compound for installing paper faced metal trim accessories.
 - 2) Fill Coat: For second coat, use setting type, sandable topping compound.
 - 3) Finish Coat: For third coat, use setting type, sandable topping compound.
 - 4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.

- b. Cementitious Units: Recommended by backer unit manufacturer.
 - c. Tile Backing Panels: Recommended by backer unit manufacturer.
 - d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
 - e. Joint Compound, Glass Mat Sheathing Board: Recommended by sheathing board manufacturer.
- G. Partition Closure:
 - 1. Description: Extruded aluminum partition closures are pre-assembled and spring-loaded to provide a tight fit for vertical junctures of partitions and window assemblies.
 - 2. Basis of Design Product:
 - a. Mullion Mate High STC manufactured by Gordon, Inc.
 - 3. Material: 6063-T5 temper, tensile strength 31 KSI (ASTM B221/ASTM B221M).
 - 4. Sound Transmission: STC 50 minimum.
 - 5. Width: As required.
 - 6. Accessories:
 - a. Partition End Caps.
 - 7. Finish: Match adjacent storefront, window wall, or curtain wall system.
- H. Moisture Guard Trim:
 - 1. Description: ASTM C1047, rigid plastic, applied to bottom edge of gypsum board.
 - 2. Height: As indicated on Drawings.
 - 3. Depth: As requi.
 - 4. Length: Greatest length available.
 - 5. Basis of Design Product:
 - a. Watertguard manufactured by Watertguard USA.
- I. Auxiliary Materials: Comply with referenced installation standards and manufacturer's written recommendations.
 - 1. Steel Drill Screws: ASTM C1002, use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. Sound Attenuation Blankets: Refer to Section 09 81 00 - Acoustic Insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

- A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
- B. Gypsum Board Assemblies: Comply with requirements in ASTM C840 applicable to framing installation.
- C. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
 2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - a. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1) Install two studs at each jamb, unless otherwise indicated.
 - 2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7 mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - b. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- D. Sound Insulation: Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- E. Gypsum Panels: Comply with ASTM C840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
 2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
 3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
 4. Form control and expansion joints with space between edges of adjoining gypsum panels.
 5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
 - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - b. Fit gypsum panels around ducts, pipes, and conduits.
 - c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.
 6. Isolate perimeter of gypsum board applied to non-load bearing partitions at structural abutments, except floors. Provide 1/4 inch to 1/2 inch (6.4 mm to 12.7 mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
 7. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Gypsum Board: Install interior gypsum board where indicated on drawings.
1. Single Layer Application:

- a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
2. Multilayer Application:
 - a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- G. Backing Panels:
 1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- H. Exterior Gypsum Board Soffits: Apply panels perpendicular to supports, with end joints staggered and located over supports.
 1. Install with 1/4 inch (6.4 mm) open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.
- I. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.
 1. Control Joints: Install control joints according to ASTM C840 (30 feet maximum), at each door and window jamb (unless noted otherwise), and in specific locations indicated on Drawings.
 2. Exterior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners.
 - b. LC Bead: Use at exposed panel edges.
 3. Interior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. Bullnose Bead: Use at outside corners.
 - c. LC Bead: Use at exposed panel edges.
 - d. L Bead: Use where indicated or necessary.
 - e. U Bead: Use at exposed panel edges.
- J. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 1. Pre-fill open joints, rounded or beveled edges, and damaged surface areas.
 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - b. Level 2: Panels that are substrate for tile.
 - c. Level 3: Where indicated on Drawings.
 - d. Level 4: For surfaces receiving flat paints.
 - e. Level 5: For surfaces receiving gloss or semi-gloss paint, subjected to severe lighting, or receiving wall covering.
4. Glass Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
5. Glass Mat Faced Panels: Finish according to manufacturer's written instructions.
- K. Installation Tolerances:
 1. Suspension System: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
 2. Installation Tolerances, Suspension System: Install suspension systems level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
- L. Fire-Resistance-Rated and Smoke Partitions Markings
 1. Each fire-resistance rated partition, smoke partition, or other wall requiring protected openings is to be marked as such as defined below.
 - a. Location: Mark walls in accessible concealed floor, floor-ceiling, and attic spaces.
 - b. Spacing: Markings shall be located within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition.
 - c. Lettering: Stenciled letters a minimum of 3 inches in height with a minimum 3/8 inch stroke in a color contrasting with the wall material (typically black) paint. Markings shall be one of the following, appropriate to the partition type, as indicated on plans.
 - 1) "SMOKE PARTITION – PROTECT ALL OPENINGS".
 - 2) "#-HR FIRE BARRIER – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.
 - 3) "#-HR FIRE WALL – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16

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SECTION 09 24 00 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Exterior plasterwork (stucco).
 - 2. Metal framing and accessories.
 - 3. Metal lath and furring.
 - 4. Accessories necessary for a complete installation.

1.3 SUBMITTALS

- A. Product Data: Submit technical data for product and accessory, including construction details and material descriptions.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: Submit samples for each type of factory prepared finish coat and for each color and texture specified, 12 inches by 12 inches (305 mm by 305 mm), and prepared on rigid backing.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable provisions of the IBC and the IECC for building enclosures.
 - 2. Fire Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E 119 by a qualified testing agency.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Perform testing on mockups according to specified requirements.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - 5. When directed, remove mockups from site.
- C. Preinstallation Conference: Conduct conference at site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cementitious materials in original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number.

- B. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 PROJECT CONDITIONS

- A. Comply with applicable requirements of ASTM C 926.
- B. Environmental Requirements: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.
- C. Cold Weather Requirements: Provide heat and protection, temporary or permanent, as required to protect each coat of plaster from freezing for at least 24 hours after application. Distribute heat uniformly to prevent concentration of heat on plaster near heat sources; provide deflection or protective screens.
- D. Warm Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.
- E. Ventilation: Provide natural or mechanical means of ventilation to properly dry interior spaces after portland cement plaster has cured.
- F. Exterior Plasterwork:
 - 1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 - 2. Apply plaster when ambient temperature is greater than 40 degrees F (4.4 degrees C).
 - 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- G. Protect contiguous Work from soiling and moisture deterioration caused by plastering. Provide temporary covering and take precautions necessary to minimize spattering of plaster on adjacent Work.
- H. Factory Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

1.7 WARRANTY

- A. Warrant the work specified for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- B. Defects shall include, but not be limited to the following:
 - 1. Cracking excessively without external causes.
 - 2. Delaminating or releasing from substrate.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Listed manufactures whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
1. Metal Lath and Accessories:
 - a. Alabama Metal Industries; (205) 366-2642.
 - b. CEMCO; (800) 775-2362.
 - c. ClarkDietrich Building Systems; (800) 543-7140.
 - d. Marino/WARE; (800) 627-4661.
 - e. Phillips Manufacturing; (800) 822-5055.
 2. Wire Fabric Lath:
 - a. Davis Wire; (800) 350-7851.
 - b. C.E. Shephard Co., L.P.; (713) 924-4300.
 - c. Keystone Steel and Wire Co.; (309) 697-7607.
 - d. K-Lath; (800) 663-0955.
 3. Plastic Accessories:
 - a. Alabama Metal Industries; (205) 366-2642.
 - b. Phillips Manufacturing; (800) 822-5055.
 - c. Plastic Components; (800) 327-7977.
 - d. Vinyl Corp.; (305) 477-6464.
 4. Acrylic Based Finish Coat:
 - a. California Stucco Product; (201) 457-1900.
 - b. Dryvit Systems; (800) 556-7752.
 - c. El Rey Solutions; A Parex Company; (877) 547-8822.
 - d. Finestone, BASF Corp; (800) 669-2273.
 - e. Omega Products International; (800) 600-6634.
 - f. Senergy, BASF Corp.; (800) 669-2273.
 - g. Sto Corp.; (800) 221-2397.
- B. Cold Formed Steel Framing: Refer to Section 05 40 00 for steel framing for exterior plaster (stucco).
- C. Steel Studs and Runners: Refer to Section 09 21 16 for steel partition framing for interior plaster.
- D. Soffit Framing: Refer to Section 05 40 00.
- E. Metal Lath:
1. Expanded Metal Lath: ASTM C 847, cold rolled carbon steel sheet with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized zinc coating.
 - a. Diamond Mesh Lath: Self furring, 3.4 lb/sq. yd. (1.8 kg/sq. m).
 2. Paper Backing: FS UU-B-790a, Type I, Grade B, Style 1a vapor retardant paper.
 - a. Provide paper backed lath at exterior locations.
- F. Accessories: Comply with ASTM C 1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
1. Metal Accessories:
 - a. Foundation Weep Screed: Fabricated from hot dip galvanized steel sheet, ASTM A 653/A 653M, G60 (Z180) zinc coating.

- b. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized-zinc coating.
 - c. Outside Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60 (Z180), hot dip galvanized zinc coating.
 - d. Cornerbeads: Fabricated from zinc or zinc coated (galvanized) steel.
 - 1) Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
 - 2) Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
 - e. Casing Beads: Fabricated from zinc or zinc coated (galvanized) steel; square edged style; with expanded flanges.
 - f. Control Joints: Fabricated from zinc or zinc coated (galvanized) steel; one piece type, folded pair of unperforated screeds in M shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - g. Expansion Joints: Fabricated from zinc or zinc coated (galvanized) steel; folded pair of unperforated screeds in M shaped configuration; with expanded flanges.
 - h. Two Piece Expansion Joints: Fabricated from zinc or zinc coated (galvanized) steel; formed to produce slip joint and square edged reveal adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.
2. Plastic Accessories: Manufactured from high impact PVC.
- a. Cornerbeads: With perforated flanges.
 - 1) Smallnose cornerbead; use unless otherwise indicated.
 - 2) Bullnose cornerbead, radius 3/4 inch (19 mm) minimum; use at locations indicated on Drawings.
 - b. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
 - 1) Square edge style; use unless otherwise indicated.
 - 2) Bullnose style, radius 3/4 inch (19 mm) minimum; use at locations indicated on Drawings.
 - c. Control Joints: One piece type, folded pair of unperforated screeds in M shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - d. Expansion Joints: Two piece type, formed to produce slip joint and square edged **[1/2 inch (13 mm)] [1 inch (25 mm)] [1-1/2 inch (38 mm)]** wide reveal; with perforated concealed flanges.
- G. Miscellaneous Materials:
- 1. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
 - 2. Fiber for Base Coat: Alkaline resistant glass or polypropylene fibers, 1/2 inch (13 mm) long, free of contaminants, manufactured for use in cement plaster.
 - 3. Bonding Compound: ASTM C 932.
 - 4. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.
 - 5. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475 inch (1.21 mm) diameter unless otherwise indicated.
 - 6. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - a. Fire Resistance Rated Assemblies: Comply with mineral-fiber requirements of assembly.

H. Plaster Materials:

1. Portland Cement: ASTM C 150/C 150M, **[Type II]**.
 - a. Color for Finish Coats: Match existing.
2. Colorants for Job Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color selected by Architect.
3. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
4. Sand Aggregate: ASTM C 897.
 - a. Color for Job Mixed Finish Coats: White.
5. Exposed Aggregates for Finish Coats: Match existing.
6. Acrylic Based Finish Coatings: Factory mixed acrylic emulsion coating systems formulated with colorfast mineral pigments and fine aggregates; for use over cement plaster base coats. Include manufacturer's recommended primers and sealing topcoats for acrylic based finishes.
 - a. Color: Selected by Architect.

2.2 PLASTER MIXES

- A. Comply with ASTM C 926 for applications indicated.
 1. Fiber Content: Add fiber to base coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.
- B. Base Coat Mixes for Use over Metal Lath: Scratch and brown coats for three coat plasterwork:
 1. Portland Cement Mix:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Job Mixed Finish Coat Mixes:
 1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
- D. Factory Prepared Finish Coat Mixes: For ready mixed finish coat plasters or acrylic based finish coatings, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Protect adjacent Work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster according to ASTM C 926.

3.3 INSTALLATION

- A. Metal Lath: Install according to ASTM C 1063.
 - 1. Partition Framing and Vertical Furring: Flat diamond mesh lath.
 - 2. Horizontal Framing: Flat diamond mesh lath.
- B. Accessories: Install according to ASTM C 1063 and at locations indicated on Drawings.
 - 1. Reinforcement for External (Outside) Corners:
 - a. Install [lath type, external corner reinforcement] [cornerbead] at exterior locations.
 - b. Install cornerbead at interior locations.
 - 2. Control Joints: Locate as approved by Architect for visual effect:
 - a. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - 1) Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
 - 2) Horizontal and Other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).
 - b. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
 - c. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 - d. Where control joints occur in surface of construction directly behind plaster.
 - e. Where plasterwork areas change dimensions, to delineate rectangular shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.4 PLASTER APPLICATION

- A. Comply with ASTM C 926.
 - 1. Do not deviate more than plus or minus 1/4 inch in 10 feet (6 mm in 3 m) from a true plane in finished plaster surfaces when measured by a 10-foot (3-m) straightedge placed on surface.
 - 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - 3. Provide plaster surfaces ready to receive field applied finishes indicated.
- B. Flat Surface Tolerances: Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, measured by a 10 foot (3m) straightedge placed at any location on surface.
- C. Walls; Base Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three coat plasterwork with 1 inch (26 mm) total thickness:
 - 1. Portland cement mixes.
- D. Plaster Finish Coats: Apply to provide dash finish.
- E. Acrylic Based Finish Coatings (Contractor Option to Plaster Finish Coat): Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.
- F. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

3.5 PLASTER REPAIRS

- A. Repair or replace Work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.
- B. Cut, patch, replace, repair, and point up plaster as necessary to accommodate other Work. Repair cracks and indented surfaces. Point up finish plaster surfaces around items that are built into or penetrate plaster surfaces. Repair or replace Work to eliminate blisters, buckles, check cracking, dry outs, efflorescence, excessive pinholes, and similar defects. Repair or replace work as necessary to comply with required visual effects.

3.6 TOLERANCES

- A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet (3mm in 3 m).
- B. Maximum Variation from True Position: 1/8 inch (3mm).

3.7 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of Work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.
- B. Remove unused materials, containers, equipment, and plaster debris.
- C. Protect plaster and maintain conditions ensuring finished plaster is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 24 00

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ceramic Tile.
 - 2. Porcelain Tile.
 - 3. Accessories as required for a complete installation.
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
 - 2. Section 07 95 13 - Expansion Joint Cover Assemblies: Expansion joint components.
 - 3. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
 - 4. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.
 - 5. Section 09 24 00 - Cement Plastering: Lath and Portland cement scratch coat, where required by the TCNA (HB) Method specified.

1.3 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2023.
- B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

- L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- O. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- P. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
- Q. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- R. ANSI A118.13 - American National Standard Specifications for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2014.
- S. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- T. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).
- U. ASTM C847 - Standard Specification for Metal Lath; 2018.
- V. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- W. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine; 2022.
- X. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2021.
- Y. ICC-ES AC308 - Acceptance Criteria for Termite Physical Barrier Systems; 2021, with Editorial Revision (2022).
- Z. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by affected installers.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Tile: 5 percent of each size, color, and surface finish combination.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
 - 2. Installer Certification:
 - a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
 - b. Apprenticeship Program: Installer has achieved Journeyworker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.
 - c. Advanced Certifications for Tile Installers (ACT): Certification in the installation of membranes, mortar bed (mud) floors, mortar (mud) walls, shower receptors, large format tile, gauged porcelain tile/panels/slabs, and grouts.
 - d. International Masonry Training and Education Foundation (IMTEF): Supervisor Certification Program (SCP).

1.7 MOCK-UP

- A. Refer to Section 01 40 00 - Quality Requirements for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up is indicated on drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.9 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Ceramic Tile:
 - a. American Olean Tile Co., a division of Mohawk Industries, Inc.: www.americanolean.com.
 - b. American Tile Company: www.americantilecompany.com.
 - c. Dal-Tile Corp., a division of Mohawk Industries, Inc.: www.daltile.com.
 - d. Interceramic, USA: www.interceramicusa.com.
 - e. Marazzi Tile, Inc., a division of Mohawk Industries, Inc.: www.marazziusa.com.
 - f. Roca Tile USA, a division of The Roca Tile Group: www.rocatileusa.com.

- g. United States Ceramic Tile Co., a division of The Roca Tile Group: www.rocatileusa.com.
 - 2. Porcelain Tile:
 - a. American Olean Tile Co., a division of Mohawk Industries, Inc.: www.americanolean.com.
 - b. American Tile Company: www.americantilecompany.com.
 - c. Concept Surfaces: www.conceptsurfaces.com.
 - d. Crossville, Inc.: www.crossvilleinc.com.
 - e. Dal-Tile Corp., a division of Mohawk Industries, Inc.: www.daltile.com.
 - f. Emser Tile: <https://www.emser.com>.
 - g. Interceramic, USA: www.interceramicusa.com.
 - h. Marazzi Tile, Inc., a division of Mohawk Industries, Inc.: www.marazziusa.com.
 - i. TileBar: www.tilebar.com.
 - 3. Tile Setting and Grout Materials: Those manufactured by tile manufacturers named above or any of the following as approved by tile manufacturer for use with their tile and to suit application.
 - a. ARDEX Engineered Cements: www.ardexamericas.com.
 - b. Bostik Inc: www.bostik-us.com.
 - c. Custom Building Products: www.custombuildingproducts.com.
 - d. H.B. Fuller Construction Products, Inc: www.tecspecialty.com.
 - e. LATICRETE International, Inc: www.laticrete.com.
 - f. Mapei Americas: www.mapei.com.
 - g. Merkrete, by Parex USA, Inc: www.merkrete.com.
 - h. Texrite: www.texrite.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 TILE SCHEDULE

- A. Tile Type T-1 :
 - 1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Portfolio.
 - c. Color: Iron Gray PF06.
 - d. Finish: Architect to select from Manufacturer's full range..
 - 2. Material: Porcelain.
 - 3. Size: Refer to Drawings
- B. Tile Type T-1 :
 - 1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Portfolio.
 - c. Color: White PF02.
 - d. Finish: Architect to select from Manufacturer's full range..
 - 2. Material: Porcelain.
 - 3. Size: Refer to Drawings
- C. Tile Type T-3 :
 - 1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Portfolio Vivid.
 - c. Color: Crimson Red Matte PF28.

- d. Finish: Architect to select from Manufacturer's full range.
- 2. Material: Porcelain.
- 3. Size: 6 inches by 24 inches. .
- D. Tile Type T-4 :
 - 1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Rigid Clay.
 - c. Color: Dune Stream.
 - d. Finish: Matte.
 - 2. Material: Ceramic.
 - 3. Size: 12 inches by 24 inches.
- E. Tile Type T-5 :
 - 1. Basis of Design:
 - a. Products manufactured by Crossville.
 - b. Line: Snippet.
 - c. Color: Lipstick Left & Right SNP23.
 - d. Finish: Architect to select from manufacturer's full range.
 - 2. Material: Ceramic.
 - 3. Size: 3 inches by 12 inches.
- F. Tile Type T-6 :
 - 1. Basis of Design:
 - a. Products manufactured by Crossville.
 - b. Line: Swatches.
 - c. Color: Lipstick Left & Right BRI23.
 - d. Finish: Architect to select from Manufacturer's full range.
 - 2. Material: Ceramic.
 - 3. Size: 3 inches by 12 inches.
- G. Tile Type T-7,8 :
 - 1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Volume 1.0.
 - c. Color: Refer to Drawings.
 - d. Finish: Architect to select from Manufacturer's full range.
 - 2. Material: Porcelain.
 - 3. Size: 12 inches by 24 inches.
- H. Tile Type T-9 :
 - 1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Portfolio.
 - c. Color: White PF02.
 - d. Finish: Architect to select from Manufacturer's full range.
 - 2. Material: Porcelain.
 - 3. Size: 12 inches by 24 inches.
- I. Tile Type T-10 :
 - 1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Portfolio.
 - c. Color: Iron Gray PF06.
 - d. Finish: Architect to select from Manufacturer's full range.

2. Material: Porcelain.
 3. Size: 2 inch by 2 inch mosaic.
- J. Tile Base TB-1, TB-2:
1. Basis of Design:
 - a. Products manufactured by Dal-Tile.
 - b. Line: Portfolio.
 - c. Color:
 - 1) TB-1: Iron Gray PF06.
 - 2) TB-2: White PF02
 2. Material: Porcelain.
 3. Size: 4 inches by 12 inches.

2.3 CERAMIC TILE

- A. Composition: ANSI A137.1 standard grade.
- B. Size: As scheduled.
- C. Thickness: Refer to Basis of Design product.
- D. Shape: As scheduled.
- E. Surface Finish: As scheduled.
- F. Color(s): As scheduled.
- G. Trim Units: Matching bead, cove, and surface bullnose shapes in sizes coordinated with field tile.

2.4 PORCELAIN TILE

- A. Composition: ANSI A137.1 standard grade.
- B. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
- C. Size: As scheduled.
- D. Thickness: Refer to Basis of Design product.
- E. Surface Finish: As scheduled.
- F. Color(s): As scheduled.

2.5 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 1. Manufacturers: Same as for tile.
- B. Metal Trim: Refer to Section 05 75 00 - Decorative Formed Metal.
- C. Thresholds: 2 inches (51 mm) wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
 1. Thickness: 1/2 inch (12.7 mm).

2.6 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.

2.7 GROUTS

- A. Provide setting and grout materials from same manufacturer.

2.8 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 1. Applications: Between tile and plumbing fixtures.

- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
 - 2. Basis of Design Product(s):
 - a. Merkrete Grout Sealer manufactured by Merkrete, by Parex USA, Inc.
- C. Tile Sealer: Stain protection for ceramic tile and porcelain tile tile.
 - 1. Basis of Design Product(s):
 - a. Aqua Mix Enrich 'N' Seal manufactured by Custom Building Products.
 - b. Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer manufactured by Rust-Oleum Corporation.
 - c. STONETECH Heavy Duty Stone Sealer manufactured by STONETECH, a division of LATICRETE international, Inc.

2.9 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Crack Resistance: No failure at 1/8 inch (3.2 mm) gap, minimum.
- B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
- C. Reinforcing Mesh: 2 by 2 inch (51 by 51 mm) size weave of 16/16 wire size; welded fabric, galvanized.
- D. Metal Lath: ASTM C847 Flat diamond mesh, of weight to suit application, galvanized finish.
- E. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
 - 1. Sound Reduction: Comply with ANSI A118.13 bonded membrane, ASTM E492, and ASTM E2179.
 - 2. Crack Resistance: No failure at 1/16 inch (1.6 mm) gap, minimum; comply with ANSI A118.12.
 - 3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
 - 4. Termite Resistance: 100 percent when tested in accordance with ICC-ES AC308.
 - 5. Uncoupling Function: Allow for separation between membrane and the mortar adhering tile to the membrane when subjected to excessive substrate movement.
 - 6. Suitable for installation over green concrete.
 - 7. Suitable for installation over wood-based substrates.
 - 8. Type: Thin-Set Mortar Adhered Sheet.
 - a. Basis of Design Product(s):
 - 1) ARDEX UI 740 Flexbone manufactured by ARDEX Engineered Cements.
 - 2) EasyMat Tile & Stone Underlayment manufactured by Custom Building Products.
 - 3) SpiderWeb II Uncoupling Mat manufactured by Custom Building Products.
 - 9. Type: Peel-and-Stick Sheet.
 - a. Basis of Design Product(s):
 - 1) Crack Buster Pro Crack Prevention Mat Underlayment manufactured by Custom Building Products.
 - 2) Whisper Mat CS Sound Control manufactured by Protecto Wrap.
- F. Sound Control Underlayment at Floors: Recycled rubber type, fully-adhered.
 - 1. Sound Reduction: Comply with ASTM E492.
 - 2. Thickness: 1/8 inch (3.2 mm), nominal.
 - 3. Basis of Design Product(s):

- a. Quietsound Acoustical Underlayment manufactured by U.S. Rubber Recycling, Inc:
www.usrubber.com/#sle.
- G. Sound Control Underlayment at Floors: Cork type, fully-adhered.
 - 1. Sound Reduction: Comply with ASTM E2179.
 - 2. Thickness: 15/64 inch (6 mm), nominal.
 - 3. Applications: Accepted for use as part of tile installation method F-135 on concrete floors in accordance with TCNA (HB).
 - 4. Basis of Design Product(s):
 - a. R60 Premium Cork Underlayment manufactured by Amorim Cork Composites S.A.
- H. Sound Control Underlayment at Floors: Cork and recycled rubber composite type, fully-adhered.
 - 1. Sound Reduction: Comply with ASTM E2179.
 - 2. Thickness: 13/64 inch (5 mm), nominal.
 - 3. Applications: Accepted for use as part of tile installation method F-135 on concrete floors in accordance with TCNA (HB).
 - 4. Basis of Design Product(s):
 - a. RCLT500 Rubber Cork Composite Underlayment manufactured by Amorim Cork Composites S.A.
- I. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch (11 mm) thick; 2 inch (51 mm) wide, alkali-resistant, coated glass fiber mesh tape for joints and corners.
- J. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
 - 1. Standard Type: Thickness 1/2 inch (12.7 mm).
 - 2. Fire Resistant Type: Type X core, thickness 5/8 inch (15.9 mm).
- K. Backer Board: High density polystyrene with reinforced cementitious coating on both sides; with compatible alkaline resistant joint tape; to be covered with waterproofing prior to installation of tile.
 - 1. Thickness: 1/2 inch (12.7 mm).
- L. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 - 2. Follow moisture and alkalinity remediation procedures in Section 09 05 61 - Common Work Results for Flooring Preparation.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.

- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Install thresholds where indicated.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 CLEANING

- A. Clean tile and grout surfaces.

3.5 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 30 00

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SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Suspended metal grid ceiling system.
 - 2. Suspended plastic grid ceiling system.
 - 3. Acoustical units.
 - 4. Supplementary acoustical insulation above ceiling.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Placement of special anchors or inserts for suspension system.
 - 2. Section 05 31 00 - Steel Decking: Placement of special anchors or inserts for suspension system.
 - 3. Section 07 21 00 - Thermal Insulation; Acoustical insulation.
 - 4. Section 08 31 00 - Access Doors and Panels: Access panels.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- G. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- H. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- L. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- M. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

- N. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
- O. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.
- P. CHPS (HPPD) - High Performance Products Database; Current Edition at www.chps.net/.
- Q. ISO 14644-1 - Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration; 2015.
- R. ITS (DIR) - Directory of Listed Products; Current Edition.
- S. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- T. UL (FRD) - Fire Resistance Directory; Current Edition.
- U. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Samples: Submit two samples 6 by 6 inch (150 by 150 mm) in size illustrating material and finish of acoustical units, including edge.
- F. Samples: Submit two samples each, 6 inches (150 mm) long, of suspension system main runner, cross runner, and perimeter molding.
- G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of each type installed, to a minimum of one box of each..

1.6 QUALITY ASSURANCE

- A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 55 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Acoustic Panels:
 - a. Armstrong World Industries, Inc.: www.armstrongceilings.com.
 - b. Acoustic Ceiling Products, Inc.: www.acpideas.com.
 - c. Acoustics First Corporation: www.acousticsfirst.com.
 - d. CertainTeed Corporation: www.certainteed.com.
 - e. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
 - f. Nelson Industrial, Inc: www.nelsonii.com/arch.
 - g. TECHLITE: www.techlite.com.
 - h. USG Corporation: www.usg.com/ceilings.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 PANELS

- A. General Requirements: ASTM E1264, Class A.
 - 1. VOC Content: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. VOC Content: Certified as Low Emission by one of the following:
 - a. Product listing in UL (GGG).
 - b. Product listing in CHPS (HPPD).
- B. Acoustical Ceiling Panels (ACS-1): Painted mineral fiber, with the following characteristics:
 - 1. Basis of Design:
 - a. Fine Fissured manufactured by Armstrong World Industries.
 - 2. Classification: ASTM E1264 Type III.
 - a. Form: 1, nodular.
 - b. Pattern: "A" - perforated, regularly spaced large holes.
 - 3. Size: 24 by 24 inches (610 by 610 mm).
 - 4. Thickness: 5/8 inch (16 mm).
 - 5. Minimum NRC Range: 0.55, determined in accordance with ASTM E1264.
 - 6. Articulation Class (AC): N/A.
 - 7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 8. Panel Edge: Square.
 - 9. Color: White.
- C. Metal-Faced Acoustical Ceiling Panels (ACS-3): Aluminum flat formed sheet, with glass fiber acoustical media backing; with the following characteristics:
 - 1. Basis of Design:
 - a. Metalworks, Perforations manufactured by Armstrong World Industries.
 - 2. Classification: ASTM E1264 Type VII.
 - a. Pattern: "A" - perforated, pattern: M15.
 - 3. Size: 24 by 24 inches (610 by 610 mm).
 - 4. Thickness of Metal: 1 inch.
 - 5. NRC Range: 0.70 determined in accordance with ASTM E1264.
 - 6. Panel Edge: Square.
 - 7. Color: Custom matched to PT-2.

- D. Acoustical Ceiling Panels (ACS-4): Mineral fiber with membrane-faced overlay for use in areas with indirect lighting, with the following characteristics:
 - 1. Basis of Design:
 - a. Backstage Noir manufactured by Armstrong World Industries, Inc.
 - 2. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured..
 - 3. Size: 24 by 24 inches (610 by 610 mm).
 - 4. Thickness: 5/8 inch.
 - 5. NRC: 0.75, determined in accordance with ASTM E1264.
 - 6. Ceiling Attenuation Class (CAC): 30, determined in accordance with ASTM E1264.
 - 7. Panel Edge: Square.
 - 8. Color: Black.
 - 9. Suspension System: Exposed.
 - 10. Suspension System: As indicated on Drawings.
- E. Acoustical Ceiling Panels (ACS-5): Painted mineral fiber, with the following characteristics:
 - 1. Basis of Design:
 - a. Fine Fissured manufactured by Armstrong World Industries.
 - 2. Classification: ASTM E1264 Type III.
 - a. Form: 1, nodular.
 - b. Pattern: "A" - perforated, regularly spaced large holes.
 - 3. Size: 24 by 24 inches (610 by 610 mm).
 - 4. Thickness: 5/8 inch (16 mm).
 - 5. Minimum NRC Range: 0.55, determined in accordance with ASTM E1264.
 - 6. Articulation Class (AC): N/A.
 - 7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 - 8. Panel Edge: Square.
 - 9. Color: Black.

2.3 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Cord Reels (ACTA):
 - 1. Basis of Design: Suspended Ceiling Kit as manufactured by Legrand AV.
 - 2. Size: 2 feet by 2 feet by 1.1 inch.
 - 3. Color: White.
 - 4. Manufacturer to provide vertical mounting bracket.
- C. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- D. Hold-Down Clips: Manufacturer's standard clips to suit application.
- E. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
- F. Wood Veneer Panel Safety Clips: Galvanized 1-9/16 by 5-1/2 inch (40 by 139 mm) bent sheet metal clips screw anchored to back of adjacent panels and spanning over top of suspended tee grid.
 - 1. Wire Ties: No. 12 galvanized wire.
- G. Wood Veneer Perimeter Trim: Field cut wood veneer panels to match acoustic ceiling panels.
 - 1. Support: Aluminum L angle, 1/8 inch (3.2 mm) thick.
- H. Perimeter Moldings: Same metal and finish as grid.
 - 1. Size: As required for installation conditions and specified Seismic Design Category.
 - 2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

3. Shadow Molding: Shaped to create a perimeter reveal.
 - a. Basis of Design:
4. Channel Molding: U-shaped, for hold-down type installations.
5. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
6. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.
- I. Metal Edge Trim for "Cloud" Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
 1. Trim Height: As indicated on Drawings.
 2. Finish: Baked enamel.
 3. Color: As indicated on Drawings.
- J. Ceiling Pockets with Prewired Raceway: UL 325 listed, extruded aluminum shade pocket with removable closure panel and acoustical unit support, for recess mounting in suspended acoustical or drywall ceilings; size and configuration as indicated on drawings.
 1. Designed to accommodate installation of motor control and wiring accessories within pocket.
- K. Acoustical Insulation: Refer to Section 07 21 00 - Thermal Insulation.
- L. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Locate system on room axis according to reflected plan.
- E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 1. Install in bed of acoustical sealant.
 2. Use longest practical lengths.
 3. Overlap and rivet corners.
- F. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Seismic Suspension System, Seismic Design Category C: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Maintain a 3/8 inch (9 mm) clearance between grid ends and wall.

- H. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch (19 mm) clearance between grid ends and wall.
- I. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- J. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- K. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- L. Do not eccentrically load system or induce rotation of runners.
- M. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.
- N. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Lay acoustical insulation for a distance of 48 inches (1219 mm) either side of acoustical partitions as indicated.
- I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- J. Install hold-down clips on panels within 8 ft (2.5 m) of an exterior door.
- K. Install plastic lay-in panels at following minimum distance from conventional light sources:
 - 1. Halogen, 60 Watt: 14 inches (355 mm) minimum.
 - 2. Incandescent, 120 Watt: 15 inches (380 mm) minimum.
 - 3. Quartz Halogen, 500 Watt: 23 inches (584 mm) minimum.
- L. Install safety clips on wood veneer panels 2 inches (51 mm) from outside edge of panel and at 24 inches (610 mm) on center.
 - 1. Use wire ties to attach safety clips.
- M. Install wood veneer trim using aluminum L angle to attach to suspended grid system as required for application.

3.5 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 51 00

SECTION 09 64 66 - WOOD ATHLETIC FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood athletic flooring.
 - 2. Subflooring.
 - 3. Sleepers.
 - 4. Resilient cushioning.
 - 5. Sheet vapor retarder.
 - 6. Floor finishes.
 - 7. Surface finishing.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 03 30 00 - Cast-in-Place Concrete: Concrete subfloor surface; recessed.
 - 3. Section 03 30 00 - Cast-in-Place Concrete: Formed depressions for deep floor sockets and inserts.
 - 4. Section 06 10 00 - Rough Carpentry: Subfloor blocking.
 - 5. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
 - 6. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
 - 7. Section 09 90 00 - Painting and Coating: Product requirements for surface finish materials for application in this section.
 - 8. Division 26 - Electrical: Electrical floor cover plates.

1.3 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- D. ASTM F2772 - Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems; 2011 (Reapproved 2019).
- E. DIN EN 14904 - Surfaces for Sports Areas – Indoor Surfaces for Multi-Sports Use – Specification; 2006.
- F. MFMA (PUR) - Performance and Uniformity Rating Sport Specific Standards; current edition.
- G. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data for flooring, floor finish materials, and resilient cushion.
- C. Shop Drawings: Indicate floor joint pattern and termination details.
 - 1. Indicate provisions for expansion and contraction, wall base, and game insert or socket devices.
 - 2. Indicate size and type fasteners and anchors.
 - 3. Indicate location, size, design, and color of game markings.
- D. Samples: Submit two samples 6 inches by 6 inches in size showing floor finish, color, and sheen.
- E. Test Reports: Submit test reports showing compliance with DIN EN 14904.
- F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- G. Manufacturer's Instructions: Indicate standard and special installation procedures.
- H. Maintenance Data: Include maintenance procedures and recommended maintenance materials.
- I. Manufacturer's qualification statement.
- J. Installer's qualification statement.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Flooring Material: 10 square yards (9 sq m) matching installed flooring.

1.6 QUALITY ASSURANCE

- A. Perform work of this section in accordance with MFMA (SPEC).
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
 - 1. Minimum three years of documented experience.
 - 2. Member mill of the Maple Flooring Manufacturers Association, Inc (MFMA).
- C. Installer Qualifications: Company specializing in installing products specified in this section.
 - 1. Minimum three years of documented experience.
 - 2. MFMA accredited and approved by flooring manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver materials and store off the floor in a well-ventilated, weather-tight space.

1.8 FIELD CONDITIONS

- A. Do not install wood flooring until wet construction work is complete and permanent heat and air conditioning is installed and operating.
- B. Maintain room temperature between 55 degrees F (13 degrees C) and 75 degrees F (24 degrees C) and relative humidity between 35 to 50 percent for a period of seven days prior to delivery of materials to installation space, during installation, and after installation.
- C. Acclimate wood flooring materials to installation space a minimum of 48 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Wood Athletic Flooring:
 - a. Aacer Flooring: www.aacerflooring.com/#sle.
 - b. Action Floor Systems; Action Anchor Flex: www.actionfloors.com/#sle.
 - c. Connor Sports Flooring: www.connorfloor.com/#sle.
 - d. Grid; Click Wood: www.builtbygrid.com/#sle.
 - e. Robbins Sports Surfaces: www.robbinsfloor.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 WOOD ATHLETIC FLOORING

- A. General: Wood athletic flooring, system components provided by single manufacturer.
 - 1. Gymnasium System Description:
 - a. Fixed, cushioned sleeper system, wood strip flooring.
 - 2. Basketball Court System Description:

2.3 COMPONENTS

- A. Wood Strip Flooring (New Gym):
 - 1. Provide MFMA grade-marked flooring, stamped as manufactured by MFMA member mill.
 - 2. Basis of Design: Robbins Bio Cushion Classic System.
 - 3. Species: Northern hard maple, kiln dried; tongue and groove edges, end matched.
 - 4. Grade: First or better on court and grade Three or better around court.
 - 5. Cut: Edge grain.
 - 6. Pad: 3/4 inch.
 - 7. Moisture Content: 7 to 9 percent.
 - 8. Thickness: 25/32 inch (20 mm).
 - 9. Width: 2-1/2 inch.
- B. Wood Strip Flooring (Existing Gym):
 - 1. Basis of Design: Robbins Bio Cushion Classic System.
 - 2. Species: Northern hard maple, kiln dried; tongue and groove edges, end matched.
 - 3. Grade: Third and better.
 - 4. Cut: Edge grain.
 - 5. Pad: 7/8 inch.
 - 6. Thickness: 25/32 inch (20 mm).
 - 7. Width: 2-1/2 inch.
 - 8. Length: Random, minimum of 9 inches (230 mm).
- C. Sleepers:
 - 1. Length: 48 inches (1200 mm).
 - 2. Softwood lumber, 2 by 4 inch (50 by 100 mm) nominal.
 - 3. Plywood, 7/8 inch by 4 inch (22 mm by 100 mm) nominal.
- D. Subflooring: Two layers of 15/32 inch (12 mm) thick plywood, APA rated, exposure 1, minimum span rating of 32/16.
- E. Channels: Galvanized steel, manufacturer's standard size and shape for system indicated.
- F. Resilient Cushioning: Manufacturer's standard rubber pads, factory-applied to bottom side of sleepers.

1. Thickness:
 - a. WGW1 - 3/4 inch.
 - b. WGW2 - 7/16 inch.
- G. Resilient Underlayment: Polyethylene foam sheet.
 1. Thickness: 6 mil.
- H. Vapor Retarder: Polyethylene sheet, 6 mil (0.15 mm) thick; 2 inch (50 mm) wide tape for sealing sheet seams.
- I. Fasteners and Anchors: Manufacturer's standard type and size to suit application.

2.4 FINISHES

- A. Floor Finishes: Types recommended by flooring manufacturer and complying with MFMA specifications.
 1. Sealer: Oil based urethane.
 2. Finish Coats: Oil based urethane; high gloss.
 3. Game Marking Paint: Compatible with sealer and finish coats; colors as indicated on drawings.

2.5 ACCESSORIES

- A. Ventilating Base: Molded rubber, 4 inch high with a 3 inch toe, pre-molded outside corners; black color.
- B. Edge Strip: Angle; clear anodized aluminum.
- C. Transition Strip: Same species and finish as flooring material; profiles indicated.
- D. Game Socket Devices: Cast aluminum type, with anchors.
- E. Adhesives: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/4 inch in 10 feet (6 mm in 3 m).
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
 2. Follow moisture and alkalinity remediation procedures in Section 09 05 61 - Common Work Results for Flooring Preparation.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare substrate to receive wood flooring in accordance with manufacturer's and MFMA instructions.
- B. Vacuum clean substrate.

3.3 INSTALLATION

- A. General: Comply with wood athletic flooring manufacturer's written instructions, but not less than written recommendations of MFMA applicable to flooring type indicated.
- B. Place vapor retarder over concrete surface, overlap seams a minimum of 6 inches (150 mm) and seal with tape.
- C. Resilient Underlayment: Install in accordance with manufacturer's instructions.

- D. Sleepers with Plywood Subfloor:
 - 1. Place sleepers at 90 degree angle to direction of finished floor; space 12 inches (300 mm) on center. Stagger end joints a minimum of 24 inches (610 mm).
 - 2. Anchor sleepers to concrete substrate with steel anchoring pins.
 - 3. For floating applications, do not secure sleepers to structure.
 - 4. Fasten plywood subfloor over sleepers at 45 degree angle to direction of finished floor. Allow minimum 1/4 inch (6 mm) between plywood subfloor edges.
 - 5. Fasten solid lumber subfloor over sleepers at 45 degree angle to direction of finished floor; space as indicated on Drawings.
- E. Double Layer Plywood Subfloor:
 - 1. Place first layer at 45 degree angle to direction of finished floor, resilient pad side down.
 - 2. Fasten second layer (without pads) at 45 degree angle to first layer.
 - 3. Allow 1/4 inch (6 mm) between plywood subfloor edges.
- F. Subfloor:
 - 1. Install shock absorbing pads per manufacturer's recommendations.
 - 2. Install the lower subfloor perpendicular to the intended finish flooring direction. All joints shall be staggered 4-foot and spaced 1/4-inch apart.
 - 3. Install bleacher blocking per manufacturer's recommendations.
 - 4. Install solid blocking at doorways, under bleachers in the stacked position, and below portable goals and install stop blocking at extended bleacher wheel locations.
 - 5. Install the upper subfloor diagonal to the lower subfloor panels staggering joints 4-foot and spacing 1/4-inch apart. Secure these panels using adhesive (Box X patten) and 1-inch staples spaced 6-inches on center at panel perimeter and 12-inches on center throughout interior.
- G. Install solid blocking at doorways, under stacked bleachers, under locations of heavy equipment, and as shown on drawings, in accordance with flooring manufacturer's recommendations.
- H. Wood Flooring:
 - 1. Install in accordance with manufacturer's and MFMA instructions.
 - 2. Lay flooring parallel to length of main playing area. Blind nail or staple to subfloor.
 - 3. Install edge strips at unprotected or exposed edges, and where flooring terminates.
 - 4. Provide 2 inch (24 mm) expansion space at walls and other interruptions.
- I. Install base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside corners.
- J. Install floor sockets and inserts to a depth sufficient to ensure flush top surface with floor surface.
- K. Finishing:
 - 1. Mask off adjacent surfaces before beginning sanding.
 - 2. Sand flooring to smooth even finish with no evidence of sander marks. Remove dust by vacuum.
 - 3. Apply finishes in accordance with floor finish manufacturer's and MFMA instructions.
 - 4. Apply one sealer coat and three finish coats.
 - 5. Apply first coat, allow to dry, then buff lightly with recommended pad to remove irregularities. Vacuum clean and wipe with damp, lint-free cloth before applying succeeding coats.
 - 6. Apply game lines/markers in accordance with layout indicated on drawings.
 - 7. Apply last coat of finish.

3.4 CLEANING

- A. Clean floor surfaces in accordance with floor finish manufacturer's instructions.

3.5 PROTECTION

- A. Prohibit traffic on finished floor for 72 hours after installation.
- B. Place protective coverings over finished floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION 09 64 66

SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient sheet flooring.
 - 2. Resilient tile flooring
 - 3. Installation accessories.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Division 26: Electrical floor cover plates for installation of resilient flooring specified in this section.

1.3 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- B. ASTM F970 - Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading; 2022.
- C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2018).
- D. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2021).
- E. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2019.
- F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 6 by 6 inch (150 by 150 mm) in size illustrating color and pattern for each resilient flooring product specified.
- D. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 78 23 - Operation and Maintenance Data for additional provisions.
 - 2. Extra Flooring Material: Provide extra flooring material equal to 1 percent of each type and color of installed flooring, minimum of 10 square feet (1 square meters).

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Do not double stack pallets.

1.7 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 GENERAL REQUIREMENTS

- A. Unless noted otherwise, all Resilient Flooring shall comply with the following:
 - 1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.

2.3 RESILIENT SHEET FLOORING

- A. Vinyl Sheet Flooring - RFS-1: Homogeneous without backing, with color and pattern throughout full thickness.
 - 1. Basis of Design:
 - a. Manufacturer: Patcraft.
 - b. Collection: Holistic Shades.
 - c. Color: 00111 Radiant.
 - 2. Minimum Requirements: Comply with ASTM F1913.
 - 3. Thickness: 0.079 inch (2 mm) nominal.
 - 4. Static Load Resistance: 250 psi (1725 kPa) minimum, when tested as specified in ASTM F970.
 - 5. Seams: Chemically bonded using seam sealer.
 - 6. Integral Cove Base: 4 inches.
 - a. Match RFS-1.
- B. Vinyl Sheet Flooring - RFS-2, RFS-3: Homogeneous with backing, with color and pattern throughout full thickness.
 - 1. Basis of Design:
 - a. Manufacturer: Forbo..
 - b. Collection: Marmoleum Modular.
 - c. Color:
 - 1) RFS-2: T5217 Withered Prairie.
 - 2) RFS-3: T5231 Cliffs of Moher.

2. Minimum Requirements: Comply with ASTM F 2034, Type 1.
 3. Gauge: 1/10 inch (2.5 mm).
 4. Backing: Jute.
 5. Size: 39.37 inches by 9.84 inches.
 6. Pattern: Refer to finish plan.
 7. Seams: Heat welded.
- C. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.4 RESILIENT TILE FLOORING

- A. General Requirements
1. Size(s): As indicated on Drawings.
- B. Vinyl Composition Tile - RFT-1: Homogeneous, with color extending throughout thickness.
1. To match existing.
 2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.

2.5 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Adhesive for Vinyl and Rubber Flooring:
1. Manufacturers: Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. H.B. Fuller Construction Products, Inc: www.tecspecialty.com.
 - b. Loba-Wakol, LLC: www.loba-wakol.com.
 - c. Stauf USA, LLC: www.staufusa.com.
- C. Moldings, Transition and Edge Strips:
1. Metal Moldings, Transition and Edge Strips: Refer to Section 05 75 00 - Decorative Formed Metal.
 2. Resilient Moldings, Transition and Edge Strips: Refer to Section 09 65 13 - Resilient Base and Accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive cove base.
- C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- F. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Cut sheet at seams in accordance with manufacturer's instructions.
- C. Seal seams by heat welding where indicated.
- D. Chemically bond seams using seam sealer where indicated.
- E. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.5 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.6 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.7 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 65 00

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes
 - 1. Resilient base, adhesive attached, in locations shown on drawings.
 - 2. Resilient subfloor transitions.

1.3 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.4 REFERENCES

- A. Florida Department of Education State Requirements for Educational Facilities (SREF), Current Edition
- B. Florida Building Code (FBC), Sections 453 and 468.
- C. Uniform Fire Safety Standards for Educational Facilities, Chapter 69A-58 F.A.C.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to demonstrate compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. Actual samples or color charts showing manufacturer's full range of colors, for Architect's selection (if selections are not already scheduled or otherwise indicated on the drawings).
 - 2. Actual 12-inch-long piece of base material in each color selected for approval.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Burke Flooring.
 - 2. Flexco.
 - 3. Johnsonite.
 - 4. Mannington.
 - 5. Nora Rubber Products.
 - 6. Roppe Corp.
 - 7. Tarkett.

2.2 MATERIALS

- A. Standard Rubber Base (typical except where extended toe or other type of base is specifically indicated on drawings, e.g., at athletic flooring or elsewhere) (RB-1):
 - 1. Quality Standard: ASTM F1861.
 - 2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
 - 3. Manufacturing Method: Group I (solid, homogeneous)

4. Style: Topset cove; rolls of greatest length available, cut to length required to minimize joints.
 5. Minimum Thickness: Full 1/8 inch (3.2 mm)
 6. Color(s): 078 Umber.
 7. Height: 4 inches, unless indicated otherwise
 8. Corners: Job-Formed.
 9. Basis of Design: Rproducts manufactured by Flexco.
- B. Joining and Edge Finish Moldings (TR-#):
1. Usage: For use at flooring terminations with other flooring
 2. Type: Tapered or bullnose edge, as required to provide juncture at edge of adjacent floor surfaces
 3. Size: One (1) inch wide by 1/8 inch thick or as applicable to the type of flooring and condition
 4. Material: Rubber or vinyl as recommended by manufacturer to suit application
 5. Color(s): As selected by Architect from Manufacture full range .
 6. Manufacturers: Burke Flooring, Flexco, Johnsonite, Roppe, Tarkett, or Architectt approved equal.
 7. Transition Type:
 - a. Snap Down "T" (TR-1): Snap-in "T" molding joining 1/4 or 5/16 inch material on each side.
 - 1) Basis of Design: "Transitional Moldings 930" as manufactured by Mannington.
 - 2) Accessories: 970, 980, or 990 track.
 - b. Tile Carpet Joiner (TR-2): One-piece molding joining 1/4 inch carpet to 1/4 inch tile
 - 1) Basis of Design: "Transitional Moldings 150" as manufactured by Mannington.
 - c. Underslung Reducer (TR-3): Binder bar edging for 1/16 inch to 1/8 inch resilient floors with dry back.
 - 1) Basis of Design: "Transitional Moldings 735" as manufactured by Mannington.
- C. Resilient Subfloor Transition (RST):
1. Usage: Subfloor Transition System.
 2. Thickness: Varies, cut to length.
 3. Material: Rubber or vinyl as recommended by manufacturer to suit application.
 4. Basis of Design: "The Equalizer Transition" as manufactured by Mannington Commercial.
- D. Adhesive: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.
- E. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.3 EXTRA STOCK

- A. Deliver to Owner:
1. percent, or one (1) unopened carton of each color, type and size of base selected, whichever is greater.
 2. One (1) gallon container of each type adhesive used for base.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Report unsatisfactory conditions to Architect in writing. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Prepare substrates to receive base as recommended by base manufacturer.

- B. Verify substrates are smooth and ready to receive resilient base. Grind high spots and fill low spots with latex cementitious filler as required.
- C. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

- A. General:
 - 1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
 - 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Base:
 - 1. Install base where shown on the Drawings in accordance with manufacturer's instructions.
 - 2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners, as indicated on the drawings or directed by Architect.

3.4 CLEANING AND PROTECTING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION 09 65 13

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SECTION 09 67 00 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Fluid-applied, epoxy resin flooring system.
 - 2. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.
 - 2. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
 - 3. Section 09 05 61 - Common Work Results for Flooring Preparation:: Concrete slab moisture and alkalinity testing and remediation procedures.

1.3 REFERENCE STANDARDS

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- B. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).
- C. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Comparable Product.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated include manufacturer's technical data, application instructions, and recommendations for each flooring component required.
- B. Samples: Submit flooring system required, 6 inches (150 mm) square, applied to a rigid backing.
 - 1. Two samples indicating range of slip resistant textures
 - 2. Two samples of actual color and texture selected by Architect.
- C. Reports and Certificates:
 - 1. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Maintenance Data: Submit data for flooring system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements of the IBC for interior floors.
 - 2. Fire Test Response Characteristics: Determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 3. Accessibility Requirements: Comply with applicable requirements.
 - 4. Flammability: Self-extinguishing according to ASTM D635.
- B. Installer Qualifications: Installer having minimum 5 years documented experience in the installation of epoxy floors and who is a manufacturer authorized representative trained and approved for installation of flooring systems required. Engage installer certified in writing by floor manufacturer as qualified to apply flooring systems indicated.
- C. Source Limitations: Obtain primary flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- D. Pre-Installation Conference: Conduct conference at site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during flooring application and for 24 hours after application unless manufacturer recommends a longer period.

1.9 WARRANTY

- A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full year from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 PRODUCTS

2.1 PREFERRED MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. BASF Corporation: construction.basf.com.
 - 2. Crossfield Products Corp.: www.crossfieldproducts.com.
 - 3. Sherwin-Williams Company (The), High Performance Flooring: industrial.sherwin-williams.com/na/us/en/resin-flooring.html.
 - 4. Sika Corporation; Flooring: <https://usa.sika.com/en/construction/floor-wall/flooring-systems.html>.
 - 5. Stonhard Group (The): www.stonhard.com.

- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 FLUID-APPLIED, EPOXY RESIN FLOORING SYSTEM (FF-1)

- A. Basis of Design: DecoDur Flake FX as manufactured by Sikafloor.
1. Alternate Products:
 - a. DecoFlake as manufactured by Sherwin Williams.
 - b. DuraFlex as manufactured by Sherwin Williams.
 - B. System Components:
 1. Primer: Sikafloor - 161.
 2. Reciever Coat: Sikafloor 264 & Sika Decorative Flake.
 3. Top Coat: Sika Clear 340 Urethane.
 - C. Color and Pattern: Smoke.
 - D. Slip Resistance: Provide slip resistant finish.
 - E. Location: Restrooms.

2.3 INTEGRAL WALL BASE (FF-1(B))

- A. Basis of Design: Match FF-1.

2.4 FLUID-APPLIED, EPOXY RESIN FLOORING SYSTEM (FF-2)

- A. Basis of Design: DecoFlake as manufactured by Sikafloor.
1. Alternate Products:
 - a. DecoFlake as manufactured by Sherwin Williams.
 - b. DuraFlex as manufactured by Sherwin Williams.
 - B. System Components:
 1. Primer: Sikafloor - 161.
 2. 1st Body Coat: Sikafloor 264 & Sika Decorative Flake.
 3. 2nd Body Coat: Sikafloor 216 with Broadcast Decorative Flakes to rejection.
 4. Top Coat: Sikafloor 216.
 - C. Color and Pattern: Smoke.
 - D. Slip Resistance: Provide slip resistant finish.
 - E. Location:Field.

2.5 INTEGRAL WALL BASE (FF-2(B))

- A. Basis of Design: Match FF-2.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Remove existing floor covering, adhesives, and contaminates. Ensure existing concrete floor is ready to receive epoxy floor covering.
 2. Roughen concrete by Shot Blasting (mechanical preparation only) substrates complying with manufacturer's written instructions.
 3. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 4. Verify that concrete substrates are dry and moisture vapor emissions are within acceptable levels according to manufacturer's written instructions.

- a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab area in 24 hours.
 - b. Plastic Sheet Test: ASTM D4263. Proceed with application after testing indicates absence of moisture in substrates.
 - c. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
5. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Epoxy Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer/Waterproofing Membrane: Apply primer or waterproofing membrane over entire substrate surface in manufacturer's recommended thickness.
 1. Apply to integral cove base substrates.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Do not broadcast into cove. Mix quartz aggregates and add thixotropic and hand trowel. Round internal and external corners.
- D. Quartz Granules: Broadcast Quartz into Undercoat. Scrape off and vacuum up excess aggregate.
- E. Topcoats: Trowel or squeegee apply clear epoxy resin coat topcoats indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.3 CURING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 48 hours.

3.4 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

3.5 CLEANING

- A. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

END OF SECTION 09 67 00

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SECTION 09 68 00 - CARPETING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Sheet Carpeting
 - 2. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete.
 - 2. Section 09 65 13 - Resilient Base and Accessories.

1.3 REFERENCE STANDARDS

- A. AATCC Test Method 134 - Test Method for Electrostatic Propensity of Carpets; 2019.
- B. AATCC Test Method 174 - Antimicrobial Activity Assessment of New Carpets; 2022, with Editorial Revision (2023).
- C. AATCC TM 165 - Test Method for Colorfastness to Crocking: Textile Floor Coverings—Crockmeter; 2021.
- D. AATCC TM16.1 - Test Method for Colorfastness to Light: Outdoor; 2023.
- E. AATCC TM16.2 - Test Method for Colorfastness to Light: Carbon-Arc; 2023.
- F. AATCC TM16.3 - Test Method for Colorfastness to Light: Xenon-Arc; 2020.
- G. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings; 2021.
- H. ASTM D2646 - Standard Guide for Backing Fabric Characteristics of Pile Yarn Floor Coverings; 2018.
- I. ASTM D3936 - Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering; 2021.
- J. ASTM D7330 - Standard Test Method for Assessment of Surface Appearance Change in Pile Floor Coverings Using Standard Reference Scales; 2022.
- K. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- L. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- M. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- N. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- O. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- P. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 SUBMITTALS

- A. Product Data - Technical data including installation recommendations for each type of substrate:

1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Samples:
 1. For each product, each color, and texture required, provide a sample as follows. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules:
 - a. Carpet: 12 inch (300 mm) square Sample from approved color and product of carpet.
 - b. Carpet Seam: 6 inch (150 mm) Sample.
 - c. Mitered Carpet Border Seam: 12 inch (300 mm) square Sample. Show carpet pattern alignment.
 - d. Carpet accessory samples.
- C. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.
- D. Shop Drawings: Showing extent of product, seam direction, and location and type of carpet accessories. Submittal to indicate columns, doorways, enclosing walls or partitions, casework, and locations where cutouts are required.
- E. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Fire Test Response Characteristics: Provide products with the critical radiant flux classification determined by testing identical products in accordance with ASTM E648.
 2. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 3. Accessibility Requirements: Comply with applicable requirements:
 4. AQMD: Air Quality Management District, Local Regulations.
 5. SCAQMD: South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications.
 6. CRI: Carpet and Rug Institute Green Label Plus.
- B. Installer Qualifications: Installer having minimum 5 years' documented experience as a commercial carpet installer, who is certified by the International Certified Floorcovering Installers Association at the Commercial II or higher certification level.
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- D. Pre-installation Conference:
 1. Refer to Section 01 31 00 - Project Management and Coordination.

1.6 WARRANTY

- A. Written warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period:
 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excessive surface wear, excess static discharge, and delamination.
 3. Warranty Period: 25 years from date of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Store in a dry location between 65 degrees F and 90 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally, elevated above slab level on a flat surface, stacked no higher than two rolls.
- C. Store materials in area of installation for minimum period of 48 hours prior to installation.
- D. Protect carpet from damage, dirt, stains, and moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Bentley Mills: www.bentleymills.com.
 - 2. Interface, Inc.: www.interface.com.
 - 3. Mannington Commercial, a part of Mannington Mills, Inc.: www.manningtoncommercial.com.
 - 4. Milliken: www.milliken.com.
 - 5. Mohawk Industries: www.mohawkflooring.com.
 - 6. Patcraft: www.patcraft.com.
 - 7. ShawContract, part of Shaw Industries Group, Inc., a Berkshire Hathaway Company: www.shawcontract.com.
 - 8. Tandus-Centiva, a Tarkett Company: commercial.tarkett.com.
 - 9. Tarkett: commercial.tarkett.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 CARPET, GENERAL

- A. Performance:
 - 1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
 - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
 - 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
 - 4. Delamination: Not less than 4 lbf/in. (18 N/mm) per ASTM D3936.
 - 5. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D1335.
 - 6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC TM 165.
 - 7. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC TM16.1, AATCC TM16.2, and AATCC TM16.3.
 - 8. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC Test Method 174.
 - 9. Electrostatic Propensity: Less than 3.5 kV according to AATCC Test Method 134.
 - 10. Emissions: Provide carpet that complies with testing and product requirements of CRI Green Label Plus.
 - 11. Backing: Standard with manufacturer.
- B. Face Construction:
 - 1. Size: Refer to carpet type.
 - 2. Construction: Refer to Basis of Design product for minimum criteria.
- C. Backing:
 - 1. As recommended by manufacturer.

2. Adhesive System: As recommended by manufacturer.
3. Applied Soil Resistance Treatment: Manufacturer's standard.
4. Antimicrobial Treatment: Manufacturer's standard.

2.3 SHEET CARPET

- A. Sheet Carpeting, Type CP-1 :
 1. Basis of Design: Products manufactured by Tarkett .
 - a. Collection: 11647 Syllabus II.
 - b. Color: 76508 New Age.
 2. Size: Roll.
 3. Backing: Powerbond.
- B. Sheet Carpeting, Type CP-2 :
 1. Basis of Design: Products manufactured by Tarkett .
 - a. Collection: Assertive Action .
 - b. Color: Steelwork.
 2. Size: Roll.
 3. Backing: Powerbond.

2.4 ACCESSORIES

- A. Adhesives: Water resistant, mildew resistant, nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, complying with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.
- B. Trowelable Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet cushion manufacturer.
- C. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.
- D. Seam Adhesive: Hot melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints and provide accessible transitions. (11B-302)
- F. Extra Carpet: After completion of the carpet installation, the carpet subcontractor shall provide an additional three (3) percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

3.2 COORDINATION

- A. Contractor's responsibility to hire movers to move furniture as required for flooring installation. Coordinate with Owner and Architect regarding temporary furniture relocation.

3.3 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
 - 2. Prior to delivery of flooring materials, contractor shall conduct Calcium Chloride "dome" test to verify that concrete floors are dry with maximum moisture vapor emissions of 3 lbs. per 1000 square feet. in 24 hours, and exhibit negative alkalinity, carbonation or dusting. Apply moisture test in four different areas of each floor location with at least one test for each 1,000 square feet of floor area.
 - 3. Prior to delivery of carpeting, conduct Relative Humidity Test Method in accordance with ASTM F2170 using a Wagner Rapid RH probe to verify relative humidity and surface pH of concrete floor slabs, the method:
 - a. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
 - b. Place probe to full depth of test hole, place cap over probe.
 - c. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
 - d. Remove cap and press button on the probe to obtain reading.
 - e. Relative humidity readings for substrates receiving non-permeable flooring are 75% or lower.
 - 4. Testing shall require 3 tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.
 - 5. Alkalinity Testing: Concrete floors shall be tested for alkalinity prior to installation of flooring. Levels of pH shall not exceed written recommendations of flooring manufacturer or adhesive manufacturer, or both.
 - 6. Delivery of flooring materials and beginning of installation means acceptance of existing substrate and site conditions.
 - 7. Subfloor finishes comply with requirements specified in Section 03 30 00 - Cast-In-Place Concrete for slabs receiving carpet.
 - 8. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 9. Install Vapor Emission Treatment Systems where tests reveal presence of more than acceptable moisture level in accordance with Test Method ASTM F1869 or ASTM F2170.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.4 PREPARATION

- A. Comply with CRI 104, Section 7.3 Site Conditions; Floor Preparation and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturer.

- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.5 INSTALLATION

- A. Comply with CRI 104 and carpet and carpet cushion manufacturer written installation instructions for the following:
 - 1. Direct Glue Down Installation: Comply with CRI 104, Section 9 Direct Glue Down Installation.
 - 2. Stair Installation: Comply with CRI 104, Section 13 Carpet on Stairs for glue down installation.
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position:
 - 1. Do not bridge building expansion joints with carpet.
 - 2. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
 - 3. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- D. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, Patterned Carpet Installations and with carpet manufacturer's written recommendations.

3.6 CLEANING AND PROTECTING

- A. Perform cleaning operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, Protecting Indoor Installations.
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer

END OF SECTION 09 68 00

SECTION 09 78 00 - INTERIOR WALL PANELING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Decorative wood panel system.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures.
 - 2. Section 06 83 16 - Fiberglass Reinforced Paneling.
 - 3. Section 09 21 16 - Gypsum Board Assemblies.

1.3 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturer's descriptive literature for each specified product. Include anchorage devices specific to project substrate types.
- C. Shop Drawings: Submit elevations for each application and location. Indicate details of joints and attachments.
- D. Samples: Submit two samples 12 by 12 inches (300 by 300 mm) in size, indicating finish, surface design, and color for each type of panels; provide glass samples in specified frame.
- E. Manufacturer's Instructions: Provide manufacturer's installation instructions.
- F. Installer's qualification statement.
- G. Maintenance Data: Include recommended instructions, methods, and materials for cleaning glass, aluminum framing, and FRP panels.
- H. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.
- I. Specimen Warranty: Manufacturer warranty.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Panels: Quantity equal to 5 percent of total installed, minimum of 2 panels.

1.5 QUALITY ASSURANCE

- A. Surface Burning Classification: Provide wall paneling assemblies meeting Class A when tested in accordance with ASTM E84.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of experience.
- C. Installer's Qualifications: Company specializing in installing work of the type specified in this section, and with at least three years of documented experience.

1.6 MOCK-UPS

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Construct mock-up, of wall paneling of each type, illustrating joints and trim.
- C. Locate where directed by Architect.
- D. Mock-ups may remain as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original packaging, marked with manufacturer's product identification.
- B. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Extended Correction Period: Correct defective work within a 5-year period for failure of materials or workmanship commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Decorative Wood Panel System:
 - a. American Architectural Millwork: www.millworkusa.com.
 - b. TerraMai: www.terramai.com.
 - c. PSI Panel Specialists, Inc.
 - 2. Metal Interior Wall Paneling:
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 DECORATIVE WOOD PANEL SYSTEM

- A. Basis of Design: Panawall Architectural Panel System manufactured by American Architectural Millwork.
- B. Decorative Wood Panels:
 - 1. Face Dimensions: As indicated in Drawings.
 - 2. Panel Thickness: As indicated on Drawings.
 - 3. Wood Fiber Substrate:
 - a. Medium density wood fiberboard conforming to ANSI A208.2, industrial-grade MDF or other wood fiber substrates having not less than 75% recycled wood waste.
 - 4. Wood Veneer Panels: Real Wood Veneers AA Architectural grade wood veneer laminated to wood fiber substrate, and coated with furniture grade catalyzed finish as protective topcoats.
 - a. Edges: Square cut and sealed.
 - b. Balancing Backer: Wood veneer measuring between 0.015 inch (0.38 mm) and 0.025 inch (0.64 mm).
 - c. Veneer Face: 0.010 inch (0.25 mm) to 0.015 inch (0.38 mm) with a catalyzed finish of approximately 0.003 inch (0.08 mm).
 - d. Species and Cut: As selected by Architect from manufacturer's full line.
 - 1) Grain Direction: As indicated on Drawings.

- e. Finish: 310.
 - f. Trim Color: Black.
- C. Hardware:
 - 1. Horizontal Cross Rail framing to create detailed reveals.
 - a. Furnish in full 10'-0" (3.05 m) lengths.
 - b. Basis of Design: H-HR10A manufactured by American Architectural Millwork.
 - 2. Reveal Tape.
 - a. Basis of Design: H-RT manufactured by American Architectural Millwork.
 - 3. Panel Clips.
 - 4. Panel Secure Fasteners.
 - a. Basis of Design: H-FS-1 manufactured by American Architectural Millwork.

2.3 METAL INTERIOR WALL PANELING

- A. Metal Panels: Aluminum flat formed sheet.
 - 1. Basis of Design:
 - a. Vapor Gradients manufactured by Arktura, LLC.
 - 2. Material: Aluminum sheet.
 - a. Thickness of Metal: 0.040 inch (1 mm).
 - 3. Perforations: As selected by Architect.
 - 4. Infill: Acoustic PET felt panel.
 - a. Color: As selected by Architect.
 - 5. Size:
 - a. Interior Panels: 24 by 24 inches (610 by 610 mm).
 - 6. NRC: Determined in accordance with ASTM E1264.
 - 7. Panel Edge: Manufacturer's standard.
 - 8. Finish: Powder-coated.
 - a. Color: As selected by Architect.
 - 9. Wall Attachment System: Manufacturer's standard.

2.4 ADHESIVES

- A. Type recommended by panel manufacturer.

2.5 FABRICATION

- A. All framing, panels, hardware and accessories shall be factory finished and ready to install except for field fabrication as required by jobsite and perimeter conditions.
 - 1. Refinish field cut panel edges in accordance with manufacturer's instruction before installation.
 - 2. Factory-assemble individual framing components, miter corners, and rivet corner attachments.
 - 3. For all cut-outs, drill corners for a minimum 1/8 inch radius.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer.
 - 2. Comply with adhesive manufacturer's recommendations for remedial measures at locations and application conditions where adhesion test results are unsatisfactory.
- C. Start of installation constitutes acceptance of project conditions.

3.2 PREPARATION

- A. Conditioning: Acclimatize panels to installation environment for a minimum of 72 hours prior to installation.
- B. Protect existing surfaces with drop cloths.
- C. Except as indicated on Contract Drawings, before installing, examine panels and arrange to achieve best combination of color, pattern, texture, and grain. For book matched panels follow the sequence provided by manufacturer.

3.3 INSTALLATION

- A. Install panels in accordance with manufacturer's instructions.
- B. Install panels and hardware straight, plumb, and level inless noted otherwise on Contract Drawings.
- C. Cut and drill holes in panels with carbide tipped saw blades, drill bits, or snips.
- D. Apply adhesive to back side of panel using trowel recommended by adhesive manufacturer.
- E. Apply panels to wall with vertical joints plumb and horizontal joints level and pattern aligned with adjoining panels.
- F. Using a roller, apply pressure to panel face to ensure proper adhesion between surfaces.
- G. Install panels with manufacturer's recommended gaps for panel field and corner joints.
- H. Install trim with adhesive.
- I. Seal joints at wall base and between panels with approved sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

3.4 ADJUSTING

- A. Replace paneling installed out of plumb and/or not aligned with adjacent panels or construction.

3.5 CLEANING

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean panels, framing, and trim on exposed surfaces not more than four days prior to Date of Substantial Completion in accordance with manufacturer's written recommendations.

3.6 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.

3.7 PROTECTION

- A. Protect installed interior wall paneling from subsequent construction operations.

END OF SECTION 09 78 00

SECTION 09 81 00 - ACOUSTIC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fiberglass batt acoustical insulation.
 - 2. Sprayed cellulose fiber acoustical insulation.
- B. Related Sections:
 - 1. Section 09 21 16 - Gypsum Board Assemblies: Acoustically-rated partitions.
 - 2. Section 09 90 00 - Painting and Coating: Painting of spray-applied acoustic insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).
- G. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- H. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).

1.4 SYSTEMS DESCRIPTION

- A. Contractor must use a total system, encompassing equipment, fiber and adhesive as supplied and tested by the manufacturer. No substitution.
- B. Fibers supplied under this Section shall have each bag coded with the date and lot number of manufactures and retained samples shall be kept by the manufacturer for not less than 1 year.
- C. Contractor must be licensed and trained by the manufacturer.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Certification:
 - 1. Manufacturer's certificate that the product meets or exceeds specified requirements.

2. Manufacturer's written certification that product contains no asbestos, and that sprayed-cellulose fiber acoustical insulation contains no fiberglass or other man made mineral fibers.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturers.
 2. Suppliers.
 3. Installers/Applicators.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in original, unopened containers bearing name of manufacturer, product identification and reference to U.L. testing.
- B. Store materials off ground, under cover and away from damp surfaces and keep material dry at all times.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Batt Insulation:
 - a. CertainTeed, LLC: www.certainteed.com.
 - b. Johns Manville, a Berkshire Hathaway Company: www.jm.com.
 - c. Knauf: knauf.com.
 - d. Owens Corning: www.owenscorning.com.
 2. Spray-Applied Acoustic Insulation:
 - a. International Cellulose Corporation: www.spray-on.com.
 - b. Monoglass Incorporated: www.monoglass.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 MATERIALS

- A. Acoustic Glass Batt Insulation for Use in Partitions and Over Acoustical Panel Ceilings:
 1. Basis of Design:
 - a. CertaPro AcoustaTherm manufactured by CertainTeed Corp.
 - b. Thermal & Sound Control Batts manufactured by Guardian Fiberglass, Inc.
 - c. Sound-SHIELD Sound Control Batts manufactured by Johns-Manville.
 - d. EcoBatt with ECOSE manufactured by Knauf.
 - e. Sonobatts (above ceiling) and Sound Batt (partitions) manufactured by Owens-Corning.
 2. Surface Burning Characteristics per ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 3. Thickness (minimum):
 - a. 3-1/2 inches where indicated on Drawings.
 - b. 6 inches above Acoustic Ceiling Systems as indicated on Drawings.
- B. Acoustic Glass Batt Insulation for Use over Open Ceiling Panels:
 1. Basis of Design: SelectSound Black Acoustic Blanket manufactured by Owens-Corning.
 2. Type: ASTM C553, Types I and II.
 3. Surface Burning Characteristics per ASTM E84:

- a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 - 4. Acoustical Performance:
 - a. ASTM C423; Mounting Type A: Material placed against solid backing.
 - b. Noise Reduction Coefficient (NRC): 0.75 or 0.90 as indicated in Drawings.
 - 5. Thickness (minimum):
 - a. 1 inches (NRC 0.75).
 - b. 2 inches (NRC 0.90).
- C. Acoustic Glass Board Insulation:
 - 1. Basis of Design:
 - a. SelectSound Black Acoustic Board manufactured by Owens-Corning.
 - 2. Type: ASTM C612 types IA and IB.
 - 3. Surface Burning Characteristics per ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 - 4. Acoustical Performance:
 - a. ASTM C423; Mounting Type A: Material placed against solid backing.
 - b. Noise Reduction Coefficient (NRC): 0.75 or 1.00 as indicated in Drawings.
 - 5. Thickness (minimum):
 - a. 1 inches (NRC 0.75).
 - b. 2 inches (NRC 1.00).
- D. Spray-Applied Acoustic Insulation:
 - 1. Color: Black, unless noted otherwise.
 - 2. Field-tested bond strength report per ASTM E736/E736M: Tested at over 5 years / Not less than 400 psf / Not less than 600 times its weight at one (1) inch
 - 3. Fire Resistance per ASTM E84: Tested at a minimum of five (5) inch thickness, Class I
 - a. Flame Spread: Not To Exceed Five (5).
 - b. Smoke Development: Not To Exceed Five (5).
 - 4. Sprayed insulation shall meet appropriate Building Code Requirements.
 - 5. Thickness: 1-1/2 inch minimum typical. Thickness shall be determined in accordance with ASTM E605/E605M field test procedure.
 - 6. Bond Deflection per ASTM E759/E759M: 6 inch deflection in 10 foot span - no spalling or delamination.
 - 7. Cohesive Strength at time of application per Method WS-2000: >700 Grams.
 - 8. Basis of Design: "K-13 Spray-On-Systems" manufactured by International Cellulose Corporation.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine all surfaces and report all unsatisfactory conditions in writing to Architect. The work shall not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Provide masking, drop cloths or other satisfactory coverings for all materials/surfaces, which are not to receive insulation to prevent damage from over-spray.
- B. Surfaces to receive spray insulation shall be inspected prior to application to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains. Prime accordingly.
- C. Work shall be coordinated with other trades whose work may be affected or have an effect on the installation of the sprayed cellulose fiber.

3.3 INSTALLATION

- A. Installation, clean up and curing shall be accomplished according to the manufacturer's recommendations and common construction standards.
- B. Provide natural or mechanical ventilation continuously to properly cure the insulation.

3.4 PROTECTION

- A. Protect finished installation from damage caused by work of other trades.

END OF SECTION 09 81 00

SECTION 09 84 00 - ACOUSTIC ROOM COMPONENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fabric-covered acoustic room components.
 - 2. Wood-faced acoustic room components.
 - 3. Pre-assembled wood panels.
 - 4. Cementitious wood fiber panels
 - 5. Speaker cloth.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Miscellaneous metal supports.

1.3 REFERENCES

- A. ASTM C365/C365M - Standard Test Method for Flatwise Compressive Properties of Sandwich Cores; 2022.
- B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM E1111/E1111M - Standard Test Method for Measuring the Interzone Attenuation of Open Office Components; 2014 (Reapproved 2022).
- G. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Show panel joints, detail references, dimensions and methods of attachment.
- C. Samples: 12 inch x 12 inch sample of actual material and color charts showing manufacturer's full range of colors for Architect's selection.

1.5 QUALITY ASSURANCE

- A. Provide acoustical panels, diffusers and fabrics of each type required from one (1) manufacturer, of uniform texture and color.
- B. Installer. Provide evidence of appropriate experience in system installation and that installation method proposed is acceptable to panel manufacturer.
- C. Single Source Responsibility: Obtain acoustical panel materials from a single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Carefully protect work during shipment, storage and installation.
- B. Deliver materials to job site and store elevated above floor in an enclosed space with proper ventilation and protection from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Acoustical Panels:
 - a. Acoustical Resources, Inc.
 - b. Armstrong World Industries.
 - c. Autex Acoustics.
 - d. AVL Systems, Inc.
 - e. Benton Brothers Solutions, Inc.
 - f. Conwed Designscapes.
 - g. Decoustics.
 - h. Finelite, Inc.: www.finelite.com,
 - i. Golterman & Sabo, Inc.
 - j. Kirei USA, LLC.
 - k. Lamvin, Inc.
 - l. MBI Products Company.
 - m. Rockfon.
 - n. Sky Acoustics.
 - o. Sound Concepts.
 - p. Wall Technology, Inc.
 - q. TURF.
 - 2. Fabric Facings:
 - a. Guilford of Maine.
 - 3. Wood Fiber Acoustical Panels:
 - a. Cardinal Acoustics: www.cardinalacoustics.com.
 - b. Tectum, a division of Armstrong World Industries, Inc.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Fabric-Faced Acoustical Room Components:
 - 1. Acoustical Room Component Type 1 (ARC-1): All panels over 7 feet-0 inches above finished floor.
 - a. Basis of Design Product/Manufacturer: "Basic Series Acoustical Panel" manufactured by Acoustical Resources, Inc.
 - b. Type: Absorber Panels.
 - c. Thickness: 9 mm.
 - d. Color: Blue Papier 539.
 - e. Core Composition: 6-7 PCF medium density single glass fiber core.
 - f. Flame Spread: Class A, 25 or less.
 - g. NRC: 1.05 in accordance with ASTM C423.
 - h. Panel Edge Profile: Square, chemically hardened.
 - i. Color: 04 Light Gray.

- j. Size: Two (2) inches thick by size shown on drawings.
 - k. Location: "Main Street" See interior elevation.
 - l. Mount: Z-Clip.
2. Acoustical Room Component Type 2 (ARC-2): All panels below 7 feet-0 inches above finished floor.
- a. Basis of Design: "Impact Resistant / Tackable Series" Acoustical Panel manufactured by Acoustical Resources, inc.
 - b. Type: Absorber Panels – Impact Resistant, Tackable.
 - c. Core Composition: 6-7 PCF medium density single glass fiber core laminated with 1/8 inch thick compressed high density acoustically transparent glass fiber face of 16-20 PCF.
 - d. Color: Medium Grey 298.
 - e. Flame Spread: Class A, 25 or less.
 - f. NRC: 0.95 in accordance with ASTM C423.
 - g. Panel Edge Profile: Square, chemically hardened.
 - h. Size: Two (2) inches thick by size shown on drawings (2-1/8 inch overall)
 - i. Location: "Main Street" See interior elevation.
 - j. Mount: Z-Clip.
3. Acoustical Room Component Type 3 (ARC-3):
- a. Basis of Design: "Basic Series" or "Impact Resistant Acoustical Panel" manufactured by Acoustical Resources, Inc.
 - b. Type: Absorber Panels. Provide impact resistant panels where indicated on Drawings.
 - c. Color: Cardinal 738.
 - d. Core Composition: 6-7 PCF medium density single glass fiber core.
 - e. Flame Spread: Class A, 25 or less.
 - f. NRC: 1.10 in accordance with ASTM C423.
 - g. Panel Edge Profile: Chamfered, chemically hardened.
 - h. Size: 4 inch thick by size indicated on Drawings.
 - i. Location: "Main Street" See interior elevation.
 - j. Mount: Z-Clip.
4. Acoustical Room Component Type 5 (ARC-5,6,7):
- a. Basis of Design:
 - 1) Ceiling Baffle as manufactured by TURF.
 - b. Baffles:
 - 1) Type: Ceiling-hung, acoustic baffles.
 - 2) Composition: Medium-density, glass fiber core.
 - 3) Length: See RCP details.
 - 4) Panel Edge Profile: Manufacturer's standard.
 - 5) Size: 2.25 inches by 24 inches deep.
 - 6) Cable to deck, verify cable length needed.
 - 7) Color: As indicated on Drawings.
 - c. Suspension System: As recommended by manufacturer.
5. Acoustic Room Component (ARC-8,9): Absorber Panel
- a. Basis of Design Product/Manufacturer:
 - 1) Composite Baffles as manufactured KMDI.
 - b. Color:
 - 1) ARC-8: Wood Finish to match control sample.
 - 2) ARC-9: Match PT-6.
 - c. Size: 2 inches by 6 inches.
 - d. Length: Varying, refer to Drawings.

- e. Mounting Type: As recommended by Manufacturer..
- f. Flame Spread: Class A, 25 or less.
- g. Size: 2 inches thick by size shown on drawings.
- 6. Fabric Facing: 100 percent polyester fabric, Guilford of Maine Anchorage - 2335 Series in colors selected by Architect from manufacturer's full range of colors, or approved equal. Finish shall be applied directly to face and edges of the panel and returned onto the back of the panel to provide a full finished edge. All corners shall be fully tailored.
- 7. Mounting Accessories:
 - a. Top Clips and Brackets:
 - 1) Factory mounted concealed mechanical "Z" clips screw fastened to the back of resin hardened spots on panel at maximum 24 inch on center spacing.
 - 2) Set clips inboard one (1) to two (2) inches from panel edges.
 - 3) "Z" clips shall engage on galvanized single or double wall brackets with closed ends to prevent lateral panel movement.
 - 4) Clips shall be fabric covered if exposed to view.
 - b. Bottom: 6 inch hook & loop brackets shall be shimmed on stacked spacer panels to provide even face alignment.
- B. Cementitious Wood Fiber Panels:
 - 1. Acoustical Room Component Type 13 (ARC-13): Cementitious Wood Fiber Panels
 - a. Basis of Design: "Tectum Finale" manufactured by Armstrong World Industries, Inc.
 - b. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
 - c. Thickness: 2 inches.
 - d. Size: Custom.
 - e. NRC: 0.80.
 - f. Frame: None.
 - g. Color: To match PT-5.
 - h. Mounting Style: As recommended by Manufacturer.
 - i. Location: As indicated on Drawings.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify dimensions to insure proper fabrication of materials.

3.2 INSTALLATION

- A. Install wall panels, ceiling diffusers, and fabrics only after all wet work has been completed and temperature conditions approximate conditions when space will be occupied.
- B. Install wall panels, ceiling diffusers, and fabrics in accordance with manufacturer's instructions and approved shop drawings.
- C. Install Tectum Wall Panels on Natatorium walls with venting space between the wall and panels in accordance with manufacturer's instructions.
- D. Install wall panels, and ceiling diffusers in proper alignment. Shim wall track as necessary to provide a level frame work.
- E. Arrange wall panels symmetrically on each wall, unless otherwise indicated, Remove wall panels, ceiling diffusers, and fabrics are damaged and unacceptable to Architect and replace with new undamaged materials at no expense to Owner.

END OF SECTION 09 84 00

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Surface preparation and field painting of exposed items and surfaces.
 - 2. Field preparation and painting of factory primed metal products and fabrications.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.
- C. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints; 2017.
- D. ASTM D2805 - Standard Test Method for Hiding Power of Paints by Reflectometry; 2011 (Reapproved 2018).
- E. ASTM D4828 - Standard Test Methods for Practical Washability of Organic Coatings; 1994.
- F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- H. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

1.4 DEFINITIONS

- A. Standard coating terms defined in ASTM D16 apply.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
 - 2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
 - 3. Semi-gloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
 - 4. Gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.

2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.
3. Exterior Product Approvals:
 - a. Manufacturer shall certify that product complies with and has been tested and approved in compliance with Florida Product Approval or Miami Dade NOA and applicable requirements.
 - b. Exterior Product Approvals: Manufacturer shall certify that product complies with large [and small] missile impact criteria and has been tested and approved in compliance with Florida Product Approval or Miami Dade NOA and applicable requirements.
- C. Samples: Submit for each type of paint system and in each color and gloss of topcoat.
 1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
 3. Submit samples on following substrates for review of color and texture only:
 - a. Concrete: Provide two 4 inch square samples for each color and finish.
 - b. Concrete Masonry: Provide two 4 inch x 8 inch samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
 - d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.
- D. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
 2. Performance and Durability:
 - a. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - b. ASTM D2486 Standard Test Method for Scrub Resistance of Interior Wall Paint.
 - c. ASTM D2805 Standard Test Method for Hiding Power of Paints by Reflectometry.
 - d. ASTM D4828 Standard Test Method for Practical Washability of Organic Coatings.
- B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.
- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

- D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.8 FIELD CONDITIONS

- A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).
- B. Do not thin or add water to waterbased paints, including waterbased alkyds.
- C. Weather Conditions:
1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
 2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.
 3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).
- D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
 2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- E. Provide lighting level of 80 foot candles (860 lux) measured midheight at substrate surface.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

1.9 WARRANTY

- A. Written warranty signed by the manufacturer and the installer in which the manufacture and installer agree to repair or replace paint and primers that fail within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Flaking or delamination of paint with the substrate.
 - b. Rust, scale, similar imperfections due to improper surface preparation.
 - c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
 - d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
 - e. Deterioration or loss of color of paint beyond normal weathering.
 2. Warranty Period: One year from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. The Sherwin-Williams Company: www.sherwin-williams.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Basis of Specifications: The Sherwin-Williams Company.
- B. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
- C. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including percent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.
- D. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
- E. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.
- F. Material Quality: Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.
- G. Chemical Components of Interior Paints and Coatings: Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and SCAQMD 1113.
 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 2. Restricted Components: Paints and coatings shall not contain components restricted by the EPA and SCAQMD 1113.
- H. Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- I. Patching Materials: Latex filler compatible with paint systems.
- J. Fastener Head Cover Materials: Latex filler.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
 1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.4 PAINT COLOR SCHEDULE

- A. Colors (P-#):
 - 1. P-1 - :
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: SW 7042, Shoji White.
 - c. Sheen: As selected by Architect.
 - d. Locations: As indicated on Drawings.
 - 2. P-2 - :
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: Custom Mix Match, Pantone: PMS 187 C.
 - c. Sheen: As selected by Architect.
 - d. Locations: As indicated on Drawings.
 - 3. P-3 - :
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: SW 7075 Web Gray.
 - c. Sheen: As selected by Architect.
 - d. Locations: As indicated on Drawings.
 - 4. P-4 - :
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: SW 7030 Anew Gray.
 - c. Sheen: As selected by Architect.
 - d. Locations: As indicated on Drawings.
 - 5. P-5 - :
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: SW 6990 Caviar.
 - c. Sheen: As selected by Architect.
 - d. Locations: As indicated on Drawings.
 - 6. P-6 - :
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: As selected by Architect.
 - c. Sheen: As selected by Architect.
 - d. Locations: As indicated on Drawings.
 - 7. P-7 - :
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: As selected by Architect.
 - c. Sheen: As selected by Architect.
 - d. Locations: As indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.
- B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Fiber Cement Board: 12 percent.
 - c. Masonry (Clay and CMUs): 12 percent.
 - d. Wood: 15 percent.

- e. Gypsum Board: 12 percent.
 - f. Plaster: 12 percent.
- 2. Test cementitious and plaster cement/stucco for alkalinity (pH).
- C. Gypsum Board Substrates: Verify taped joints are tapes and finishing compound is sanded smooth.
- D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.
- E. Spray Textured Ceiling Substrates: Verify surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
 - 1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.
 - a. Note: Previously painted surfaces have failed to accept new paint systems. Determined cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.
- G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

3.2 ITEMS TO RECEIVE PAINT

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
 - 1. All ferrous metal.
 - 2. All exterior galvanized metal.
 - 3. All exterior wood.
 - 4. All interior wood.
 - 5. All prime coated hardware.
 - 6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
 - 7. All metal grilles, except aluminum, unless otherwise indicated.
 - 8. All exposed gypsum board surfaces, including all mechanical rooms.
 - 9. Miscellaneous other items which normally require painting or are scheduled to be painted.
 - 10. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
 - 11. All exposed mechanical equipment and electrical equipment.
 - 12. Traffic lanes and parking spaces including fire lanes and crosswalks.
 - 13. Rolling doors.
 - 14. Bollards.
 - 15. Loose lintels.
 - 16. Refer to MEP specifications for additional items to receive paint.
- B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

- A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
 - 1. Pre-Primed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or pre-primed substrates.
 - 2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
 - 3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
 - 4. Seal marks which may bleed through surface finishes.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting.
 - 1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
 - 2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
 - 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
 - 5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.
- C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 - 1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
 - 2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - 3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 - 4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - 5. Aluminum Substrates: Remove surface oxidation.
- D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.

- E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.
- F. Renovated Surfaces: Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
 - 1. Remove surface film preventing proper adhesion and bond.
 - 2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
 - 3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
 - 4. Clean corroded iron and steel surfaces.
 - 5. Repair and blend into portland cement plaster.
 - 6. Prime bare surfaces.
 - 7. Tone varnished surfaces with stain bringing to uniform color.
 - 8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify Owner and do not proceed until correcting unsatisfactory conditions.
- G. Cementitious Substrates: Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - 1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
 - 2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
 - a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
 - b. Anhydrous Calcium Chloride Test: ASTM F1869 . Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.3 kg of water/92.9 sq. m).
 - c. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
 - d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
 - e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.
 - 3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.
- H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
 - 1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 - 2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- I. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- J. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.
- K. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.
- L. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- M. Plaster/Stucco Substrates: Remove contaminants, release agents, curing compounds, efflorescence, chalk, mold, mildew, and similar deterrents. Spot patch existing plaster to eliminate blisters, buckles, excessive crazing, and to check cracking, dryouts, efflorescence, sweat outs, and similar defects the prevent plaster from bonding with paint or coatings. Sand or texture repair or patch to match adjacent finish and to remove trowel marks and arrises.
 1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 2. Deep Cracks: Clean out and fill deep cracks with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 3. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions. Test for alkali using litmus paper.
 4. Allow patching and repair compounds to set and cure before painting.
- N. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- O. Wood Substrates:
 1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 2. Sand surfaces that will be exposed to view, and dust off.
 3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- P. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.
- Q. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
 1. Assure compatibility with product of wall covering manufacturer.
 2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
 3. Apply release coat in accordance with manufacturer's recommendations.

- R. Barrier Coat: Provide barrier coats over incompatible primers or remove and reprime. Notify Owner in writing of anticipated problems using specified finish coat material over previously coated substrates.
- S. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Do not use thinners for water based paints.
 - 4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
 - 1. The term exposed surfaces includes areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
 - 2. Use applicators and techniques suited for paint and substrate indicated.
 - 3. Provide finish coats compatible with primers.
 - 4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
 - a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
 - b. Areas visible when permanent or built in fixtures, grilles, convector covers, covers for finned tube radiation, and similar components are in place.
 - c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
 - 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - 7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
 - 11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

12. Provide finish coats compatible with primers used.
 13. Sand lightly between each succeeding enamel or varnish coat.
- B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.
- E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
 3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
 6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.
- G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
 1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
 6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- H. Electrostatic Spray Painting: Apply coating electrostatically to finished surfaces, free from runs, sags, visible overlaps, holidays, craters, pinholes and other defects detrimental to protective and decorative qualities of coating.
 1. Thickness of Coatings: 1.5 to 2.0 mils dry film thickness. Measure dry film thickness with magnetic gauge.
 2. Use application techniques, equipment, materials, and preparation procedures recommended by manufacturer.
- I. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.
- J. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.
- K. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
 1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
 2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- M. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
 1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.

2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

3.5 FIELD QUALITY CONTROL

- A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

- A. It is of the upmost important to the Owner that the sites remain in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.
- B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.
- F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer's recommendations and environmental regulations.

PART 4 SCHEDULES

4.1 GENERAL

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Overhead Painting (Ceilings, Exposed to Structure Above, etc.)
 1. Use a dryfall system comparable to system defined below for substrate.

4.2 SHERWIN-WILLIAMS APPLICATION SCHEDULES

- A. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
 1. Galvanized Metal:

- a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
 2. Galvanized Metal: Chloramine environment.
 - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Primer: One (1) coats Macropoxy 646 (B58-600).
 - c. Finish: Two (2) coats Acrolon 218 HS Acrylic Polyurethane (B65-600).
 3. Un-galvanized Metal:
 - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310).
 - b. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
 4. Pre-Finished Metal Surfaces:
 - a. Surface Preparation: As recommended by primer manufacturer.
 - b. Primer: One (1) coat Bond-Plex Waterbased Acrylic.
 - 1) OR
 - 2) Primer: One (1) coat DTM Bonding Primer.
 - c. Finish: Two (2) coats Bond-Plex Waterbased Acrylic.
 5. Concrete and CMU:
 - a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat.
 6. Tilt-Up Concrete:
 - a. Primer: One (1) coat Loxon Concrete and Masonry Primer Sealer (LX02W50), 5.3-8.0 mils wet, 2.1-3.2 mils dry.
 - b. Finish: One (1) coat Conflex UltraCrete Acrylic Textured Finish, Texture: Fine, Base Color: CF17W0811 Medium Extra White.
 7. Wood (Includes plywood siding and wooden trim):
 - a. Primer: One (1) coat A-100 Latex Wood Primer (B42W41).
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 ser.).
 8. Fiber-Cement Materials:
 - a. Primer: One (1) coat Loxon Masonry Primer (A24W300).
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 Series).
 9. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)
- B. Interior Surfaces:
 1. Concrete Substrates, Non-Traffic Surfaces and Clay Masonry:
 - a. Latex System:
 - 1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Eg-Shel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - (d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.

- b. Water-Based Light Industrial Coating System:
 - 1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- 2. Concrete Substrates, Pedestrian Traffic Surfaces:
 - a. Latex Floor Enamel System:
 - 1) First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - 2) Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.
- 3. Flat: Galvanized Metal:
 - a. Latex System:
 - 1) Prime Coat: One (1) coat Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - 2) Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Semi-Gloss: Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - (b) Gloss: Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - b. Water-Based Dry-Fall System:
 - 1) Top Coat:
 - (a) Flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-181 Series, at 6.0 mils (0.152 mm) wet, 1.5 mils (0.038 mm) dry.
 - (b) Eggshell: Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-82, at 6.0 mils (0.152 mm) wet, 1.9 mils (0.048 mm) dry.
 - (c) Semi-Gloss: Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83, at 5.8 mils (0.147 mm) wet, 2.3 mils (0.058 mm) dry.
 - c. Water-Based Light Industrial Coating System:
 - 1) Prime Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - 3) Top Coat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- 4. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
 - a. Shop coat by others.
 - b. One (1) coat over Steel Kem Kromik Primer B50series.
 - c. One (1) coat over Aluminum Metal Procryl Primer B60series.
 - d. Two (2) coats PM200 Alkyd Semi-Gloss B34series.
- 5. Wood: (Painted)
 - a. Latex System:

- 1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
- 2) Intermediate Coat: Latex, interior, matching topcoat.
- 3) Topcoat:
 - (a) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - (b) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (c) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- b. Water/Alkyd Urethane System:
 - 1) Prime Coat: Premium Wall & Wood Primer, B28W8111, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry.
 - 2) Intermediate Coat: Water-based alkyd-urethane, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Semi-Gloss: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - (b) Gloss: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
- c. Water-Based Light Industrial Coating:
 - 1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - 3) Topcoat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
6. Wood: (Stained)
 - a. Stain: SherWood BAC Wiping Stain (S64 Series).
 - b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series).
 - c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series).
7. Gypsum Board and Plaster:
 - a. Latex System:
 - 1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - (d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - b. Water-Based Light Industrial Coating System:
 - 1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.

- 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- 3) Topcoat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- 8. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
 - a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46).
 - b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60).
- 9. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
 - a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
 - b. Finish: Two (2) coats bright aluminum paint.

END OF SECTION 09 90 00

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SECTION 09 91 00 - TRANSLUCENT PANEL RESTORATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and field application of coatings on exterior substrates where shown or required.
- B. Surfaces not included, as applicable to the project, include, but are not limited to the following:
 - 1. Fiberglass translucent sandwich roof and wall panels.

1.2 SUBMITTALS

- A. Material lists. Give the supplier's name, product name, number and generic description of each proposed product and its use. Provide product data sheets if so requested.
- B. Samples. Submit full range of colors, patterns, textures and finishes available for selection, including the following:
 - 1. Sheen Samples: Provide full range of varying sheens when sheens are controllable by intermixing.
- C. Installed Samples. Provide large size samples for approval. Approved samples may be left in place as part of the work.
- D. Certification. Furnish a letter certifying that materials submitted are truly equivalent or better than those called out in the finish schedule.

1.3 RESPONSIBILITY OF COORDINATION

- A. Coordinate the work specified herein with the following work:
 - 1. Provide information to preceding trades for proper preparation of substrate.
 - 2. Inspect substrate before proceeding to verify proper preparation.

1.4 QUALITY ASSURANCE

- A. Materials:
 - 1. Delivery and Storage: Products shall be delivered to jobsite in unopened containers bearing manufacturer's labels intact and legible at time of use. Storage shall be in designated areas away from excessive heat and open flames and in accordance with manufacturer's recommendations.
 - 2. Quality or Grade:
 - a. Coatings shall be the manufacturer's highest professional quality material of types specified and shall be applied directly from containers in which material is purchased, except where thinning is recommended by manufacturer and approved by Architect to suit intended use.
 - b. Primers shall be those produced by same manufacturer as finish coats.
 - c. Thinners shall be those recommended by manufacturer's printed instructions.
 - 3. Equipment:
 - a. Spray Equipment: Shall be the type recommended for the application and shall be maintained clean and in proper working order.
 - b. Brushes, Rollers, etc.:
 - 1) Shall be new of the various sizes and types recommended for each application.

- 2) Shall be properly cleaned and stored in accordance with manufacturer's instructions at the end of each days' use.
- 3) Shall be replaced as often as necessary to attain the best finish quality in the Work.
4. Application:
 - a. Applicator:
 - 1) Shall be person(s) or entity specializing in application of coatings of types specified with minimum five (5) years experience.
 - b. Application:
 - 1) Shall not proceed on surfaces which are not suitable to be coated, until such surfaces have been corrected. Notify Architect in writing of which surfaces need to be corrected and their locations. Surfaces shall be corrected by the responsible trades. Surfaces not suitable for coating shall include, but not be limited to:
 - a) Damaged surfaces.
 - b) Oily, greasy, dusty or excessively soiled surfaces.
 - c) Non-sanded/prepared surface.
 - 2) Number of coats of each of several finishes shall be in accordance with detailed specifications, which will produce first quality finish if properly applied. If number of coats specified fails to produce a finish acceptable to Architect, this Contractor shall apply additional coat or coats at his own expense until acceptable finish is achieved

1.5 PRODUCT HANDLING

- A. Store only approved materials at the jobsite, and store only in a suitable and designated area restricted to the storage of materials and related equipment.
- B. Temperature in the storage area shall be between 60 degrees F and 80 degrees F. Open and mix all materials in the storage area.
- C. Use all means necessary to protect materials before, during, and after application and to protect the installed work and materials of all other trades.
- D. Apply coating only when temperature of surfaces to be coated and surrounding air temperatures are between 45 degrees F and 95 F, unless otherwise permitted by manufacturer's printed instructions.
- F. Do not coat in snow, rain, fog or mist, or when relative humidity exceeds 90 percent, or to damp or wet surfaces, unless otherwise permitted by manufacturer's printed instructions.

1.6 WARRANTY

- A. The undertaking of a coating subcontract will indicate that the subcontractor will warrant the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Manufacturers Pro-Rata Limited Material Warranty of 10 years.
- C. In the event of damage, immediately make all repairs and replacements necessary for approval of the Architect and at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. All materials selected for coating systems for each type of surface shall be the product of a single manufacturer and shall, as a system, have flame spread, fuel contribution, and smoke density test results less than 25.
 - B. Basis of Design "GACOFLEX UA790".
 - C. GE Optic 3101
- C. Similar first line material of the submitted manufacturers may be used subject to approval by the Architect for items indicated to be coated.

2.2 MATERIALS

- A. Coatings: Field catalyzed coatings; having good flow and brushing properties and consistent drying or curing behavior, free of sags and streaks.
- B. Accessory Materials: Linseed oil, turpentine, paint thinners and other materials recommended by coatings manufacturer as necessary to achieve finishes specified.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that site environmental conditions are appropriate and substrates are in proper condition to receive Work of this Section.
- B. Verify that shop applied primers are compatible with specified finish coats.

3.2 ITEMS TO RECEIVE COATING

- A. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements.

3.3 PREPARATION

- A. General: Surface must be clean to insure adhesion. Remove oil and grease with paint thinner. Wash off dirt with warm soapy water and rinse with clean water. Remove rust by wire brushing or sanding.
- B. Sand fiber-bloomed translucent panel in two passings with gritted sand paper on automated sander per coating manufacturers printed instructions.
- C. Rope off the area within 150 feet of spray area.
- D. Seal off ventilation intakes within the affected area.
- E. Use windbreaks, where necessary to confine spray mist and avoid damage to nearby surfaces due to overspray or drift.
- F. Keep spectators and personnel away from spray area.

- G. Be sure to take proper precautions to not spray over unprotected energized lighting or electrical outlets. Doing so could be a fire hazard. Electrical wiring and conduit can be sprayed on as long as open energized circuits are protected.
- H. Wall surfaces must be dry before coating.

3.4 APPLICATION

- A. General: Surfaces to be finished must be clean, dry and free of dirt, oils, or any other contamination that would adversely affect adhesion, protective properties or appearance of the coating.
- B. Allow coating to dry 72 hours between coat.
- C. Leveling: Apply with proper consistency and quality so coating flows out to a level surface free of brush and roller marks, bubbles, dust, runs, sags, and holidays. Spread evenly.
- D. Appearance: Uniform texture and sheen.
- E. Install coating a 3 Gallons per 100square feet to achieve specified warranty.
- F. Neatness: Coating shall not be smeared, spattered or run over materials. Cut-on lines shall be straight.

3.5 CLEANING AND PROTECTION

- A. Keep project premises free of coating-related debris. Collect material that may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Protect work adjacent to operations from coating spatters and spills. Immediately remove coating that falls on finished surfaces not scheduled to receive coating, using materials and techniques that will not damage affected surfaces.

END OF SECTION

SECTION 09 96 16 - PROTECTIVE COATING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section specifies furnishing all labor and materials to prepare surfaces and to apply protective coatings. The term "paint" as used in this section means the protective coatings specified. Major items to be coated include but are not limited to the proposed equipment, piping, structural concrete and miscellaneous structural steel.

1.02 SUBSTITUTIONS

- A. Whenever a product is designated by trade name with provision for an approved equal, the product specified must be used unless a written request for substitution is submitted to the Engineer in accordance with "Pre-approved Equivalent" components. The submittal must include the manufacturer's complete technical data sheets on the proposed product.
- B. Consideration will be given only to those products which have been used in water supply plant service for at least five years. The submittal must include a list of at least 10 applications in the Gulf Coast area where the product has been in continuous use for at least five years. Furnish the owner's name, the owner's representative and name of product used.

1.03 DELIVERY AND STORAGE

- A. Delivery: Have paint delivered to the job site in original unopened containers. Contact engineer for inspection before beginning painting operations.
- B. Storage: Store materials in an approved location. Repair any damage done and keep the storage area clean. Remove oily rags, waste, or other fire hazards from buildings each night, and take adequate precautions to avoid damage by fire. Place all cloths and cotton waste which might constitute a fire hazard in metal containers or destroy at the end of each day.

1.04 REFERENCE STANDARDS

- A. Material and application methods used in painting must comply with requirements of the Steel Structures Painting Council publications: Volume I, "Good Painting Practices" and Volume II, "Systems and Specifications". Follow the standard procedures except where otherwise specified herein. Consult the Engineer concerning any points not specified in the referenced standards or this section.

1.05 SUBMITTALS

- A. Before beginning work, submit to the engineer a certificate from the paint supplier stating that sufficient paint has been purchased to provide the coatings specified in this section. Also list on the certificate, the quantities and types of paint purchased.

PART 2 PRODUCTS

2.01 COLOR SCHEDULE

- A. Color selections are to be made by the engineer prior to application.

2.02 TEST EQUIPMENT

- A. Supply one of each of the following new pieces of equipment for the use of the Engineer.
1. Mikrotest: Model DFG-100, 0-40 mils firm thickness gage including a set of U.S. Department of Commerce Bureau of Standards Film Thickness Calibration Standards from 0-3 mils and 10-25 mils.
 2. Tinker-Razor: Model M-1, Low Voltage Flaw Detector (holiday detector).
 3. Vis-1: Pictorial standard as per SSPC Guide to Vis-1.

PART 3 EXECUTION

3.01 WORK CONDITIONS

- A. Weather: No coating work shall be done under unfavorable weather conditions, unless work is well protected and specific approval is obtained from the Engineer. Do not paint when the ambient temperature is below 50°F. (unless additional drying time as recommended by the paint manufacturer is allowed), when the surface temperature is below the dew point or when humidity is above that recommended by the paint manufacturer.
- B. Surface: If surfaces to be painted cannot be put in proper condition for painting by customary cleaning and sanding operations, notify the Engineer in writing or assume the responsibility for and rectify any unsatisfactory finish resulting from application to an unsatisfactory surface. Do not apply paint to a wet or damp surface.
- C. Materials:
1. All coating materials, abrasives, and all equipment used in painting and blasting shall be subject to inspection at any time by the Engineer or his representative.
 2. Remove all abrasive material and dust associated with the blasting operations from the surface to be painted before paint application is begun.
- D. Equipment: Maintain all equipment of the work in good working order comparable to that described in printed instructions of coating manufacturer. Clean all equipment thoroughly before and after use with appropriate cleaning solution indicated by coating manufacturer.
- E. Methods:
1. Coated areas shall have a uniform film, free of sags, runs or brush marks. Where multiple coats of paint are present, each coat must be free of shadows and uniform in appearance.
 2. Except where otherwise specified, thin only as necessary for workability of coating material in accordance with manufacturer's printed instructions. Use only appropriate manufacturer's thinner.
 3. When paint is being applied inside an enclosure adequate ventilation will be provided.
 4. Carefully observe minimum between coat-drying times as stated in printed instructions of the coating manufacturer.
 5. Provide a suitable cover or plug for the intake pipe at the point where the pipe enters the

water or air compartment to prevent abrasives, debris, or any other foreign matter from entering the water or air mains. Leave the cover or plug in place from beginning of the job until just prior to start-up.

6. Abrasive material may be left on the tank floor while painting the ceiling and walls provided no paint is applied to the walls within 2 feet of the floor. The remaining 2 feet of wall and the floor may be painted after removal of abrasives from interior.
7. Comply with recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, and safety precautions. The contractor must fully inform all members of his field crew of these recommendations.
8. Where inspection shows that the specified thickness is not developed, apply additional coats to produce the required film thickness.
9. Repair and re-coat improper applications as recommended by the manufacturer or as required by the engineer.
10. Do not coat pump and motor name tags, meter and gauge sight glasses, valve operator stems or other items designated by the engineer.

F. Forced Air Drying:

1. Heated Air: Circulate warm air through the tank for 8 hours holding the air temperature between 140 deg. F, and 150 degrees F. After initial drying, raise air temperature to between 160 degrees F and 180 degrees F for at least 24 hours or until all residual solvent odor is dissipated. This method of drying is to be used when ambient air temperature is below the stated minimum by the manufacturer of the materials to be applied.

- G. Cleaning: Upon completion of the work, remove all staging and scaffolding. Dispose of all containers and rubbish in an approved manner. Remove paint spots, oil or stains on adjacent surfaces and leave the entire job clean and acceptable.

3.02 PAINT APPLICATION

- A. Manufacturer's Representative: The protective coatings manufacturer will be responsible through an authorized representative to provide technical assistance to the paint contractor as needed.
- B. Workmen: Workmen employed shall be experienced and skilled in structural steel painting.

3.03 SURFACE PREPARATION

- A. Solvent Cleaning: Remove heavy deposits of grease or oil from the surface with toluene or xylene solvents prior to any other surface preparation. Neutralize and flush chemical contamination prior to any other surface preparation.
- B. Concrete Surfaces: Blast with water or abrasives, all surfaces which are scheduled to be coated.
1. The contractor shall provide a capillary waterproofing material on all concrete surfaces indicated.
 2. Capillary waterproofing materials shall be applied in two steps, or as recommended by

the manufacturer:

- a. In slurry consistency or dry powder form, in order to prevent the passage of water under pressure.
- b. Mixed in mortar consistency for filling of form tie holes, honeycombed areas, routed out cracks, reglets, and seal strips to assure the water tightness of structure.

C. Steel Surfaces in General:

1. Remove all weld splatter and rough edges and grind rough welds.
2. Use a source that provides compressed air, free of detrimental amounts of water and oil.
3. Use an abrasive which cleans the steel surface to the degree specified and forms an anchor pattern of 1.0 to 1.5 mils. Keep abrasives clean, dry, free of clay particles, corrosion-producing contaminants, oil, grease or other deleterious matter.
4. Blast only those areas that can be primed the same day or before any rust starts to form whichever occurs first. Areas which are not painted the same day must be reblasted again on the day the prime coat is applied. Remove abrasive material and accumulated dust from the surface by brush or industrial vacuum.
5. Blast surfaces to be coated, except those specified in the paragraph Power Tool Cleaning, to "white" metal in accordance with Steel Structures Painting Council Surface Preparation Specifications SSPC-SP 10, Near White Blast Cleaning. Remove mill scale, rust dirt, paint or other foreign matter. The surface should be a uniform gray color and slightly roughened to form a suitable anchor pattern for coating application. At least 95 percent of each square inch of surface area must be free of visible residues and the remainder limited to light discoloration.
6. All traces of abrasive material and dust must be removed from surfaces to receive primer or paint and other previously coated surfaces which are to receive additional coats of paint.

D. Equipment and Motors: Clean pumps and motors to be coated in accordance with Steel Structures Painting Council Surface Preparation Specifications SSPC-SP 3, Power Tool Cleaning, removing loose mill scale, loose rust, loose paint and other foreign matter.

E. Metalwork: Do not shop prime any metal work unless prior approval is given by the engineer in writing. The inspector will make an inspection of any shop primed metal at the factory.

3.04 PAINT SYSTEMS

Thickness of coatings given in the schedule are minimum dry film thickness in mils.

A. Coal Tar Epoxy: This system shall be applied at the areas specified in accordance with the following directions.

1. Surface Preparation: SSPC-SP 10 (near-white blast)
2. Coating of application:

1st Coat
8-16 dry mils

Sherwin Williams Targuard
Tnemec 46-413 Tneme-Tar, or

Carboline Bitumastic 300-M

2nd Coat
8-16 dry mils

Sherwin Williams Targuard
Tnemec 46-413 Tneme-Tar, or
Carboline Bitumastic 300-M

3. Contractor will stripe coat all welds. Contractor will apply 1st coat of coal tar with horizontal strokes, 2nd coat with vertical strokes. Total minimum dry film thickness required after 2nd coat has dried 5 days will be 16.0 mils. Contractor shall comply with all recommendations of the paint manufacturer in regard to drying time for each coat, technique of spray application, ventilation, paint thinning, safety precautions, and etc. It will be contractor's responsibility to fully inform himself and all members of his field crew of these recommendations and to comply with them in all respects.

- B. Latex System: This system shall be applied on masonry walls in the areas specified in accordance with the following:

1. Surface preparation: Remove efflorescence, chalk, dust, dirt, grease, oil, asphalt, tar, excessive mortar, mortar drippings and surface deposit of free iron.

2. Coating of application:

1st Coat
10-18 dry mils

Sherwin Williams H.D. Block Filler
Tnemec Masonry Filler
Carboline Sanitile 100

2nd Coat
2-4 dry mils

Sherwin Williams Sher-Cryl HPA
Tnemec Tneme-Cryl
Carboline Carbocrylic 3359

- C. Polyurethane: These systems shall be applied at the areas specified in accordance with the following:

1. System No. 1:

Surface preparation: SSPC-SP 3 (Power Tool Cleaning) or SSPC-SP 7 (brush-off blast)

1st Coat
3-6 dry mils

Sherwin Williams Micropoxy 646
Tnemec 50-330 Poly-Ura-Prime
Carboline Carboguard 60

2nd Coat
2-3 dry mils

Sherwin Williams Acrolon Ultra
Tnemec Series 72 Endura-Shield II
Carboline Carbothane 134 HG

2. System No. 2:

Surface preparation: SSPC-SP-10 (near white blast)

1st Coat
3-4 dry mils

Sherwin Williams Zinc Clad II
Tnemec 50-330 Poly-Ura-Prime
Carboline Carbozinc 859

2nd Coat
4-8 dry mils

Sherwin Williams Macropoxy 646
Tnemec Series-66Hi-Build Epoxoline

Carboline Carboguard 60

3rd Coat
2-3 dry mils

Sherwin Williams Acrolon Ultra
Tnemec Series 70 Endura-Shield
Carboline Carbothane 134 HG

- D. Textured Masonry: This system shall be applied to above-grade concrete surfaces not specified to receive waterproofing; full exterior height to 18 below finish grade; and be in accordance with the following:

1st Coat

Pavecrete Plus (1 bag/45 sf)
Tnemec Tnemcrete (1 gal/50 sf)
Sherwin Williams Ultracrete (1bag/50 sf)

- E. Concrete Surface Protection: This system shall be applied to both horizontal and vertical concrete surfaces and be in accordance with the following:

1. Surface Preparation: SSPC-SP-13 (Concrete Surface Preparation)

2. Coating of application:

1st Coat
80 dry mils

Raven Lining Systems – AquataPox A6
Carboline Plasite 4500S

4-6 dry mils
2nd Coat
75-80 dry mils

Sherwin Williams Corobond 100
Sherwin Williams Duraplate 6100

- F. Concrete Waterproofing: This system shall be applied to both horizontal and vertical concrete surfaces and be in accordance with the following:

1. Surface Preparation: SSPC-SP-13 (Concrete Surface Preparation)

2. Coating of application:

1st Coat

Vandex Super Zypex
approximately 3 lbs./sq.yd.

2nd Coat

Vandex Mortar Zypex
as required to fill voids

3.05 INSPECTION

- A. Notify the Owner's representative sufficiently in advance of all work performed under this specification.
- B. Owner's representative shall examine surface and approve preparation prior to any coating.
- C. Owner's representative shall examine and approve each coat prior to application of next coat. Areas found to contain sand, runs, over-spray, roughness or other signs of improper application shall be repaired or recoated in accordance with the manufacturer's recommendations at the contractor's expense.
- D. Completed coating shall produce minimum dry film thickness specified as determined by Mikrotest thickness gage or equivalent, and shall be free of holidays as determined by Tinker-

Razor electrical flaw detector or equivalent.

- E. Mikrotest gage or equivalent used for inspection shall be calibrated on the job site using the U. S. Department of Commerce, Bureau of Standards Film Thickness Calibration Standards. Where thickness is not developed, apply sufficient additional coats to produce the required film thickness.
- F. Owner's representative shall inspect completed coating for runs, over-spray, and roughness, and any areas found to show these or other signs of improper application shall be repaired or recoated in accordance with the manufacturer's recommendations at the contractor's expense.
- G. All repairs, surface preparations, and painting will be subject to inspection by the Engineer. Particular attention will be paid to hard-to-reach areas, bolted connections, sway rods, anchor bolts, and threaded joints. The guide lines as specified in the standards published by the Steel Structures Painting Council will be used as a basis for acceptance or rejection of the cleaning, painting, or coating application. The SSPC-Vis1-635, Pictorial Surface along with magnetic type dry film thickness gages (Mikrotest Gage), electrical holiday detectors, and standard wet film thickness gages will be used by the engineer to determine acceptability of the paint application.
- H. All areas previously coated with an existing system and to be top coated with Polyurethane System No. 1 shall be micro tested after appropriate cleaning to establish existing coating thickness prior to application of primer and polyurethane topcoat. These readings are to be recorded and reported to the Engineer.

3.06 PAINT SCHEDULE

- A. The following items shall be painted in accordance with these specifications; colors will be selected by owner from Contractor supplied color charts.

<u>Item To Be Coated</u>	<u>Coating System</u>
Piping:	
Submerged	Coal Tar Epoxy
Non-submerged	Polyurethane System No. 2
Equipment:	
Submerged	Coal Tar Epoxy
Non-submerged	Polyurethane System No. 1
Gates and Valves:	
Submerged	Coal Tar Epoxy
Non-submerged	Polyurethane System No. 2
Other Ferrous Metals:	
Submerged	Coal Tar Epoxy
Non-submerged	Polyurethane System No. 1
Concrete Structures:	
Exterior	Textured Masonry
Interior	Concrete Surface Protection
(Interior wall, floor and roof (top slab) surfaces of Pump Stations, Influent Structures, Aeration and Return Sludge Pumping Structures (2 feet below the Average Water Surface), Clarifier Launderers, and Disinfection Basin Structures)	

DIG Engineers
Project No. 240157

New CTE Center & Hargrave High School Additions & Renovations
Huffman Independent School District

CMU Structures Latex
(Excluding Color Impregnated Split-faced Block)

END OF SECTION

SECTION 09 96 53

SILICON ELASTOMERIC COATINGS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SUMMARY

Section includes substrate preparation and application of water-based acrylic elastomeric coatings to the following exterior substrates:

1. Concrete.
2. Concrete unit masonry.
3. Brick masonry.
4. Stucco.
5. Exterior insulation finish system (EIFS).

1.2 RELATED SECTIONS

6. Section 07 92 00 "Joint Sealants" for elastomeric joint sealants applied in conjunction with work of this section.

1.3 REFERENCES

ASTM International (ASTM): www.astm.org:

1. Perform adhesion test in accordance with ASTM D3359, Method A. Minimum adhesion rating of 4A required on 0 to 5 scale.
7. 40 CFR 59, Subpart D-200 - National Volatile Organic Compound Emission Standards for Architectural Coatings.
- 2.

1.4 SUBMITTALS

- A. Product Data: Give the supplier's name, product name, number and generic description of each proposed product and its use. Provide product data sheets and MSDS for each type of product.
- B. Samples. Submit full range of colors, patterns, textures and finishes available for selection, including the following:
 1. Color Chart: Submit two (2) copies of the manufacturer's standard color chart.
 2. Color Chips: Provide complete duplicate sets of color chips for color selection.
- C. Contractor Certification: Installer shall provide written documentation from the manufacturer of their authorization to install the system, and eligibility to obtain the warranty specified in this section.
- D. Preconstruction compatibility and adhesion test reports.
- E. Manufacturer's instructions for installation and field quality control testing.

- F. Field quality control adhesion test reports.
- G. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Materials:
 - 1. Delivery and Storage: Products shall be delivered to jobsite in unopened containers bearing manufacturer's labels intact and legible at time of use. Storage shall be in designated areas away from excessive heat and open flames and in accordance with manufacturer's recommendations.
 - 2. Equipment:
 - a. Spray Equipment: Shall be the type recommended for the application and shall be maintained clean and in proper working order.
 - b. Brushes, Rollers, etc.:
 - 1) Shall be new of the various sizes and types recommended for each application.
 - 2) Shall be properly cleaned and stored in accordance with manufacturer's instructions at the end of each days' use.
 - 3) Shall be replaced as often as necessary to attain the best finish quality in the Work.
 - 3. Qualifications:
 - a. Manufacturer Qualifications: Company with minimum 15 years of experience in manufacturing of specified products.
 - 4. Application:
 - a. Applicator:
 - 1) Shall be person(s) or entity specializing in application of paints and coatings of types specified with minimum five (5) years experience.
 - 5. Mockups:
 - a. Provide mockup of each coating system, color, and texture selected for approval by Architect/Consultant. Locate as indicated or as directed.
 - b. Install at Project site or pre-selected area of building an area for field sample, minimum 4 feet by 4 feet (1.2m by 1.2m), using specified material.
 - c. Apply material in accordance with manufacturer's written application instructions.
 - d. Field sample will be standard for judging workmanship on remainder of project.
 - f. Maintain field sample during construction for workmanship comparison.
 - g. Do not alter, move, or destroy field sample until Work is completed and approved by Owner.
 - h. Obtain Owners written approval of field sample before start of material application, including approval of aesthetics, color, texture, and appearance.
 - i. Perform adhesion test in accordance with ASTM D3359, Method A. Minimum adhesion rating of 4A required on 0 to 5 scale.
 - 6. Pre-Installation Meeting:
 - a. Conduct meeting at Project site.
 - b. Review requirements for waterproofing including:

2. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays
3. Site use, access, staging, and set-up location limitations
4. Surface preparation and substrate condition and pretreatment.
 - i. Special details.
 - ii. Installation procedures.
 - iii. Minimum curing period.
 - iv. Testing and inspection requirements.
 - v. Site protection measures.
5. Contractor's site foreman, waterproofing manufacturer's technical representative, waterproofing Installer, Owner's Agent, and Architect/Engineer shall attend.

1.6 PRODUCT DELIVERY, STORAGE & HANDLING

- A. Store only approved materials at the jobsite, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.
- B. Temperature in the storage area shall be between 35 degrees F and 110 degrees F. Open and mix all materials in the storage area.
- C. Use all means necessary to protect materials before, during, and after application and to protect the installed work and materials of all other trades.
- D. Do not install elastomeric coatings when temperature is above 100 deg F (38 deg C) or below 20 deg F (-6 deg C).
- E. Do not apply in snow, rain, fog or mist, or when relative humidity exceeds 85 percent, or to damp or wet surfaces, unless otherwise permitted by manufacturer's printed instructions. Application may be continued during inclement weather if areas and surfaces to be coated are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.7 Testing

- A. Upon completion of the coating membrane work, the manufacturer's representative and the contractor will calculate the coverage rate and subsequent dry film thickness of the applied coating material to ensure that the minimal requirements of this technical specification have been met. If actual dry film thickness needs to be measured, then the dry film thickness may be measured with a Tooke Gage or cutting out of a physical sample and measurement under a graded reticule microscope.
- B. If minimum dry film thickness requirements have not been met by the contractor, then additional coating membrane material must be applied by the contractor at his cost to fulfill the specification requirements.

1.9 EXTRA STOCK

- A. Upon completion of the work of this section, deliver to the Owner, an extra stock equaling ten (10) percent or a minimum of one (1) gallon, whichever is greater, of each color, type, and gloss of paint used in the work, tightly sealing each container and clearly labeling contents and location where used.

1.10 WARRANTY

- A. **Weathertight Warranty:** Provide Manufacturers standard Labor and Material Warranty form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Water penetration through the coating.
 - b. Deterioration of coating beyond normal weathering.
 - 2. **Warranty Period:** 10 years from date of Substantial Completion

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. All materials selected for coating systems for each type of surface shall be the product of a single manufacturer and shall, as a system, have flame spread, fuel contribution, and smoke density test results less than 25.
- B. Silicone Elastomeric Coating: Single-component, fluid-applied, water-based, pigmented silicone elastomer.
 - 1. Basis of Design Product: DOWSIL™ AllGuard Silicone Elastomeric Coating.
 - 2. MasterProtect EL 850 (formerly Silflex) by Master Builders Solutions
 - 3. GE SilShield* 3100 Silicone Elastomeric Coating.

2.2 MATERIALS

- A. Primers: General: VOC content of primers and fillers, 107 g/L or less.
- B. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack fillers or sealants compatible with substrate and other materials.
- C. Concrete Unit Masonry Block Filler: factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.
- D. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.

2.3 COLORS

- A. Colors shall be as selected by Designer of Record. Different colors may be selected.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The Contractor shall examine all surfaces to be coated with the specified coating membrane system to verify that it is acceptable and proper for the specified application.
- B. The Contractor shall not proceed with the scope of work until all defects in the substrate have noted, examined by the Architect/Engineer, and approved for remedial and coating work.
- C. Preinstallation Testing: Prior to application of elastomeric coatings, perform the following tests to verify condition of substrate in accordance with manufacturer's instructions:
 - 1. Adhesion: Perform substrate field adhesion tests on each substrate to determine if primer is required to satisfactorily adhere elastomeric coatings to substrates.
 - 2. Alkalinity: Verify substrate is within alkalinity range acceptable to manufacturer.
 - 3. Moisture Level: Verify substrate moisture content is acceptable to manufacturer.
- D. Proceed with coating work once conditions meet elastomeric coating manufacturer's recommendations.

3.2 PREPARATION

- A. Protection: Protect adjacent Work areas and finish surfaces from damage during coating application.
- B. Prepare surfaces in accordance with manufacturer's instructions.
- C. Ensure that substrate is sound, clean, dry, and free of dust, dirt, oils, grease, laitance, efflorescence, mildew, fungus, biological residues, and other contaminants that could prevent proper adhesion.
- D. Pressure wash (3000 psi), with the spray tip no more than 4" from the surface, all coated and bare surfaces using a high quality commercial detergent with clean water to remove all chalking effect, all loose coating material, light scale deposits and other surface contamination down to sound masonry substrate. Rinse with fresh water to ensure full cleanliness and removal of the detergent solution. Allow surfaces to dry thoroughly before continuing with surface preparation efforts. Pressure washed surfaces must be primed within a reasonable time frame before any re-contamination of the surface by airborne contaminants.

- E. Visually inspect surface. Remove loose surface features back to sound masonry substrate and power tool clean area (SSPC-SP3). In accordance with owner's aesthetic standards, fill to flush all spalled areas using the appropriate masonry repair mortar or appropriate caulking material. For heavily damaged areas, the concrete wall board shall be removed and replaced with like material.
- F. Repair holes and spalled and damaged concrete with repair materials approved by coating manufacturer.
- G. Remove protruding concrete accessories and smooth out irregularities.
- H. When chemical cleaners are used, neutralize compounds and fully rinse surface with clean water. Allow surface to dry before proceeding.
- I. Remove blisters or delaminated areas and sand edges to smooth rough areas and provide transition to existing paint areas.
- J. Check adhesion of existing paint in accordance with ASTM D3359, measuring adhesion by Tape Method A.
- K. Concrete Surfaces:
 - 1. Cure concrete a minimum of 28 days before application.
 - 2. Remove laitance, bond-inhibiting contaminants, form-release agents, and sealers.
 - 3. Remove form tie wires and repair holes, small voids, and spalls using appropriate repair product approved by coating manufacturer.
 - 4. Abrasive-blast slick, dense concrete surfaces or use primer approved by coating manufacturer. Test surface for proper adhesion.
- L. Brick and Concrete Masonry Unit (CMU) Surfaces:
 - 1. Ensure CMUs are laid true and fully cured to full load-bearing capacity.
 - 2. Remove mortar splatter and excess mortar.
 - 3. Repoint or fill voids with appropriate patching product approved by coating manufacturer.
 - 4. Ensure mortar joints are sound and free of voids and cracks.
 - 5. Apply base coat approved by coating manufacturer to new CMUs.
- M. Plaster and Stucco Surfaces:
 - 1. Clean surfaces and remove debonded or delaminated plaster or stucco.
 - 2. Repair with material approved by coating manufacturer.
 - 3. Allow new plaster or stucco to cure minimum of 14 days at 70 degrees F (21 degrees C) and 50 percent relative humidity or until pH level has reached 10. Allow longer cure times if temperatures are lower or relative humidity is higher.
 - 4. Prime chalky surfaces with primer approved by coating manufacturer after cleaning and profiling. Allow primer to dry.
- N. Exterior Insulation and Finish System (EIFS) Surfaces:
 - 1. Refasten or re-adhere delaminated or loose expanded polystyrene (EPS) insulation in accordance with manufacturer's approved methods.
 - 2. Replace or patch missing or damaged EPS to original condition.
 - 3. Finish with trowel acrylic finish to match and blend with existing texture.
 - 4. Allow repaired areas to fully cure.
 - 5. Refer to EIFS manufacturer's instructions for appropriate repair and procedures.
- O. Existing Acrylic Coating Surfaces:
 - 1. Sand or grind edges of existing coating to ensure adhesion and smooth transition of new material. Sand edges of area to featheredge.

2. Wash down and allow to completely dry.
3. Prime chalky surfaces with primer approved by coating manufacturer.
- P. Crack Preparation and Pretreatment:
 1. Treat cracks larger than 1/32 inch (0.8 mm) and up to 1/16 inch (1.6 mm) with brush-grade acrylic crack filler approved by coating manufacturer.
 2. Treat cracks larger than 1/16 by 1/16 inch (1.6 by 1.6 mm) but less than 1/4 by 1/4 inch (6 by 6 mm) with knife-grade acrylic crack filler approved by coating manufacturer.
 3. Treat moving cracks larger than 1/4 by 1/4 inch (6 by 6 mm) with internally plasticized polyurethane sealant approved by coating manufacturer.
 4. Apply test application of crack repair materials in inconspicuous location to ensure compatibility and aesthetic approval.

3.4 APPLICATION

- A. Apply coating in accordance with manufacturer's instructions.
 1. use equipment and techniques best suited for substrate and type of material being applied.
 2. coat surfaces behind movable items the same as similar exposed surfaces.
 3. apply each coat separately according to the manufacturer's written instructions.
 4. mix all coating materials in strict accordance with the instructions on the container labels and the product technical data sheets.
 5. apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration
- B. Elastomeric Coating: Apply elastomeric coating using application methods and rate of application recommended by manufacturer. Apply using nap roller, nylon brush, or airless sprayer, as allowed by authorities having jurisdiction.
 1. Apply elastomeric coating from top to bottom of substrate. Work down vertical surface and cover rundown in process. Avoid excessive overlapping.
 2. Apply coating free of cloudiness, spotting, laps, brush marks, roller tracks, and other surface imperfections. Cut in color breaks and terminations with sharp lines.
 3. Apply additional coats as required to provide cured film with uniform finish, color, and appearance.
 4. Provide a minimum of two coats of not less than 20 mil total wet film thickness (10 mil wet film thickness per coat) to provide finished dry film thickness of not less than 10 mils.
- C. Cleaning: Remove overspray and excess material using materials and methods approved by manufacturer that will not damage adjacent materials.
- D. Curing and Protection: Allow coatings to cure before exposure to traffic. Use test specimens formed at time of coating application to verify curing time. Prevent damage to coatings resulting

from construction operations or other causes. Replace damaged coatings at time of Substantial Completion.

- E. Maintain proper uniform wet-film thickness during application to ensure performance characteristics desired.
- F. Apply coating to achieve pinhole-free, consistent film build on coated surfaces.

3.5 CLEANING AND PROTECTION

- A. At the end of each work day, remove trash, empty cans, rags and other discarded materials from Project site. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.
- B. After completing coating application, clean glass and spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Remove all masking before coating material has dried and protective shrouds after coating material has dried.
- D. Protect work of other trades against damage from coating system. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect or Engineer, and leave in an undamaged condition.
- E. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

END OF SECTION

SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Porcelain enamel steel markerboards.
 - 2. Glass markerboards.
 - 3. Tackboards.
 - 4. Tackable wall panels.
 - 5. Aluminum slatwall display units.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking and supports.
 - 2. Section 06 20 00 - Finish Carpentry: Wood frame and marker rails.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
 - 4. Section 09 90 00 - Painting and Coating: Finishing of wood frame and marker rail.
 - 5. Section 10 22 39 - Folding Panel Partitions: Installation of visual display boards on operable partitions.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- C. ANSI A208.1 - American National Standard for Particleboard; 2022.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- E. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- F. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012, with Editorial Revision (2019).
- G. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- H. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- L. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.
- M. PS 1 - Structural Plywood; 2023.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.

- D. Samples: Color charts for selection of color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, and trim.
- E. Samples: Two, 2 by 2 inches (50 by 50 mm) in size illustrating materials and finish, color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surfacing, and trim.
- F. Test Reports: Show compliance to specified surface burning characteristics requirements.
- G. Manufacturer's printed installation instructions.
- H. Manufacturer's Qualification Statement.
- I. Maintenance Data: Include data on regular cleaning, stain removal.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 VISUAL DISPLAY UNITS

- A. Porcelain Enamel Steel Markerboards:
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on drawings.
 - 6. Frame: Extruded aluminum , with concealed fasteners.
 - 7. Frame Profile: As indicated on drawings.
 - 8. Frame Finish: Anodized, natural.
 - 9. Accessories: Provide map rail and 4 spring clip hangers, 2 flag holders, and 1 magnetic marker box.
 - 10. Acceptable Products:
 - a. LCS3 as manufactured by Claridge Products and Equipment, Inc.
- B. Magnetic Glass Markerboards: Back-coated glass, laminated to steel.
 - 1. Glass: Laminated, low iron, 1/4 inch thick (6 mm thick), with bevel edges and radiused corners, laminated to steel backing sheet for use with magnets. Coated or treated for use as dry erase board or projection surface.
 - 2. Glass Finish: White coating.
 - 3. Steel Backing Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
 - 4. Size: As indicated on drawings.
 - 5. Frame: Same as for porcelain enamel steel markerboards.

6. Frame Profile: As indicated on drawings.
 7. Frame Finish: Anodized, natural.
 8. Mounting: Flush.
 9. Accessories: Provide magnetic marker tray and magnetic marker holder.
 10. Acceptable Products:
 - a. DEKO. (Basis of Design).
 - b. Clarus Glass Boards.
 - c. Claridge Products and Equipment.
- C. Tackboards: Fine-grained, homogeneous natural cork.
1. Cork Thickness: 1/8 inch (3 mm).
 2. Fabric: Vinyl coated fabric.
 3. Color: As selected by Architect from manufacturer's full range.
 4. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
 5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 6. Size: As indicated on drawings.
 7. Length: As indicated on drawings.
 8. Length: 6 feet (1830 mm) , in one piece.
 9. Frame: Extruded aluminum , with concealed fasteners.
 10. Frame Profile: As indicated on drawings.
 11. Frame Finish: Anodized, natural.
 12. Accessories: Provide map rail.
 13. Acceptable Products:
 - a. Claridge Products and Equipment, Inc.
- D. Tackable Wall Panels: Fabric laminated to fiberboard; Factory-fabricated.
1. Fabric: Vinyl coated fabric.
 2. Color, Pattern, and Texture: As selected by Architect from manufacturer's full range.
 3. Backing: Fiber board, 1/2 inch (13 mm) thick, laminated to tack surface.
 4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
 5. Size: As indicated on Drawings.
 6. Edge Treatment: Square edge unless detailed otherwise.
 7. Edge Molding: Provide metal "J-mold" type edge trim for exposed edges at door and window openings and similar conditions.
 8. Adhesives: Provide manufacturer's recommended adhesive, primer, and sealer, produced for use on substrate shown on drawings. Provide materials which are mildew-resistant and non staining to wallcovering.
 9. Basis of Design Product(s):
 - a. Products manufactured by Claridge Products and Equipment, Inc.
- E. Aluminum Slatwall Display Units: Sizes and configurations indicated on drawings.
1. Finish: Anodized, natural.
 2. Acceptable Products:
 - a. Nelson Adams.

2.3 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Float Glass: Provide float-glass-based glazing unless otherwise indicated.
 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Comply with ASTM C1048.

3. Kind FT - Fully Tempered Type: Comply with ASTM C1048.
4. Fully Tempered Safety Glass: Comply with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
5. Thickness: As indicated.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
 2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
 3. Ionoplast Interlayer: 0.035 inch (0.889 mm) thick, minimum.
- D. Vinyl Coated Fabric: ASTM F793 Category VI.
- E. Burlap: Tightly woven, flame retardant treated.
- F. Plywood: PS 1 Grade C-D , softwood.
- G. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
- H. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- I. Gypsum Board: ASTM C1396/C1396M, paper/foil faced, plain type.
- J. Fiber Board: ASTM C208, cellulosic fiber board.
- K. Foil Backing: Aluminum foil sheet, 0.005 inch thick (0.13 mm thick).
- L. Aluminum Sheet Backing: 27 gauge, 0.014 inch (0.36 mm) thick.
- M. Steel Sheet Backing: 28 gauge, 0.0149 inch (0.38 mm), galvanized.
- N. Adhesives: Type used by manufacturer.

2.4 ACCESSORIES

- A. Wood Frames: Factory assembled red oak, with factory applied clear varnish finish.
- B. Wood Frames: Refer to Section 06 20 00 - Finish Carpentry.
- C. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall (; 25 mm wide overall) , full width of frame.
- D. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
- E. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- F. Flag Holders: Cast aluminum bored to receive 1 inch (25 mm) diameter flag staff, bracketed to fit top rail of board.
- G. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
- H. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- I. Marker Tray: Wood; species and finish to match frame, style as indicated on drawings.
- J. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.2 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 30 inches (760 mm) above finished floor.
- C. Secure units level and plumb.
- D. Carefully cut holes in boards for thermostats.
- E. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.
 - 1. Fabricate re-wrapped edges where partial panels abut each other, or adjacent surfaces or trim.
 - 2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
 - a. Wrap minimum 2 inches (51 mm) around back of panel.
 - b. Carefully cut fiber board, leaving vinyl wallcovering intact. Wrap wallcovering tightly around edge of board and adhere continuously around back of panel with manufacturer's recommended vinyl wallcovering adhesive.

3.4 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.
- D. Break-in slate chalkboards with a chalk and clean treatment.

END OF SECTION 10 11 00

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SECTION 10 12 00 - DISPLAY CASES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Recessed display cases.
- B. Surface-mounted display cases.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry : Blocking and supports.
- B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Submit complete printed data and installation details indicating products to be provided as specified.
 - 1. Submit color charts for selection by Architect.
- C. Shop Drawings: Submit complete installation details. Include dimensioned elevations.
- D. Samples: Submit samples of material and trim to illustrate finish, color, and texture.
- E. Manufacturer's Qualification Statement.
- F. Maintenance Data: Submit maintenance data.
- G. Specimen Warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver display cases and materials to the Project site with manufacturer's protective crate covering and do not open until ready for use.
- B. Protect display cases before, during, and after installation. In case of damage, immediately provide necessary repairs and replacements.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify field measurements for recessed application for display cases before preparation of shop drawings and before fabrication to ensure proper installation.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against defects and in materials, finish product and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Claridge Products and Equipment, Inc: www.claridgeproducts.com/#sle.
 - 2. MooreCo, Inc: www.moorecoinc.com/#sle.
 - 3. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DISPLAY CASES

- A. Recessed Display Case: Factory-fabricated wood-framed display case with adjustable glass shelves, finished interior, and aluminum trim on face to cover edge of recessed opening.
 - 1. Size: As indicated in Drawings.
 - 2. Components:
 - a. Glazed Doors: Sliding.
 - 1) Number of Doors: Two pair.
 - b. Side Panels: Stained veneer plywood.
 - c. Back Panel: Tackable.
 - d. Top Panel: Stained veneer plywood.
 - e. Bottom Panel: Stained veneer plywood.
 - f. Lighting: LED.
- B. Surface-Mounted Display Case: Factory-fabricated aluminum-framed display case with adjustable glass shelves, finished interior.
 - 1. Size: As indicated in Drawings.
 - 2. Components:
 - a. Glazed Doors: Sliding.
 - 1) Number of Doors: Two pair.
 - b. Side Panels: Tempered clear glass.
 - c. Back Panel: Tackable.
 - d. Top Panel: Stained veneer plywood.
 - e. Bottom Panel: Stained veneer plywood.
 - f. Lighting: LED.
 - 3. Free-Standing Display Case Base: Legs to match frame construction.

2.3 COMPONENTS

- A. Wood Case Construction: 3/4 inch (19 mm) 7-ply maple veneer plywood with manufacturer's standard stain.
- B. Aluminum Framed Case Construction: 1-1/2 inch by 2 inch (38 mm by 51 mm) extruded aluminum tube frame with tempered glass, laminate-faced, and stained veneer plywood infill panels.
- C. Aluminum Case Construction: Aluminum side, bottom, and top panels fabricated from extruded aluminum shapes.

- D. Face Frame Trim for Recessed Installation: 2 inch (51 mm) flat face dimension extruded aluminum trim mitered with corner clips and mechanical fasteners.
- E. Glazed Sliding Doors:
 - 1. 1/4 inch (6 mm) clear tempered glass with plastic finger pulls.
 - 2. Door track: Extruded aluminum glass shoe with bottom rollers and top plastic guide.
 - 3. Lock: Glass door cylinder lock.
- F. Glazed Hinged Doors:
 - 1. 1/4 inch (6 mm) clear tempered glass framed with 1/2 inch by 1 inch (13 mm by 25 mm) extruded aluminum trim.
 - 2. Hinges: 1 inch by .040 inch (25 mm by 1 mm) nickel-plated steel-continuous piano hinges.
 - 3. Lock: Glass door cylinder lock.
- G. Glass Shelves:
 - 1. 1/4 inch (6 mm) clear tempered glass with flat-polished edges.
 - 2. Shelf Depth: 6 inches (152 mm).
 - 3. Shelves per Unit: Two.
- H. Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - 1. Standards Mounting: Recess-mounted into back panel.
 - 2. Face Width: 5/8 inch (16 mm).
 - 3. Material: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.
 - 4. Lengths: As indicated on drawings.
 - 5. Finish: Anochrome.
 - 6. Brackets: Boltless with lip front; 16 gauge, 0.0598 inch (1.52 mm) sheet steel, reinforced, locking into slots; size to suit shelves; same finish as standards.
- I. Tackable Back Panel: Fine-grained, homogeneous natural cork on hardboard.
 - 1. Cork Thickness: 1/8 inch (3 mm).
 - 2. Fabric: Vinyl fabric; minimum fabric weight: 13 oz/sq yd (440 g/sq m).
 - 3. Color, Texture, Weave, and Pattern: As selected from manufacturer's full range.
 - 4. Backing: Hardboard, 1/4 inch (6 mm) thick, factory laminated to tack surface.
 - 5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
- J. Laminate Back Panel: Low-pressure laminate on one face of plywood substrate.
 - 1. Laminate Color and Texture: As selected from manufacturer's full range.
- K. Lighting: Manufacturer's standard LED light fixture housed at top of case with louvered aluminum access door with keyed lock.
 - 1. Surface Mounted: Under cabinet type fixture.
 - 2. Recessed: Fixture with egg crate diffuser.
 - 3. Controls: On/Off using dedicated wall switch.

2.4 MATERIALS

- A. Aluminum Extrusions for Framing and Trim: Alloy as recommended by manufacturer for construction and specified finish; nominal 1/8 inch (3.2 mm) wall thickness.
- B. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper.
 - 1. Finish: Factory anodized; AAMA 611: Clear anodized.
- C. Plywood: Softwood plywood with veneer core, waterproof glue, 3/4 inch (19 mm) thick.
- D. Heat-Strengthened and Fully Tempered Glass: ASTM C1048, Kind FT.

PART 3 EXECUTION

3.1 PREPARATION

- A. Rough openings, electrical pre-wiring, and final finishing are by other trades.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide factory trained installers.
- C. Locate fastening devices to secure cases securely to back and sides of rough opening.
- D. Install recessed display cases plumb and level in wall openings, 36 inches from finished floor to inside bottom of display case.
- E. Refer to drawings for display case mounting heights.
- F. Provide vinyl wrapped H-moldings to match vinyl covered boards.
- G. Clean case and glass using manufacturers recommended procedures.
- H. Provide mitered and wrapped hairline joints for all trims.

3.3 ADJUSTING AND CLEANING

- A. Verify that all accessories are installed as detailed for each unit.
- B. At completion of work, clean glass surfaces, back panels and trim in accordance with manufacturer's recommendations leaving units ready for use.

3.4 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures, for closeout submittals.

END OF SECTION 10 12 00

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Room and door signs.
 - 2. Plaque.
- B. Related Sections:
 - 1. Section 05 51 00 - Metal Stairs: Photoluminescent stair nosings.
 - 2. Section 05 52 00 - Metal Railings: Photoluminescent handrail strips.
 - 3. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
 - 4. Section 26 05 53 - Identification for Electrical Systems.
 - 5. Section 26 51 00 - Interior Lighting: Exit signs required by code.

1.2 REFERENCE STANDARDS

- A. 19 TAC 61.1031 - School Safety Requirements; Current Edition.
- B. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- D. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.
- E. California Building Code (CBC) - 2022 California Building Code, Title 24, Part 2; 2022.
- F. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- H. NFPA 170 - Standard for Fire Safety and Emergency Symbols; 2021.
- I. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.
- J. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on Drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from the Owner through the Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by the Owner through the Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.

- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Manufacturer's Qualification Statement.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Flat Signs:
 - a. Best Sign Systems, Inc: www.bestsigns.com.
 - b. Cosco Industries: www.coscoarchitecturalsigns.com.
 - c. FASTSIGNS: www.fastsigns.com.
 - d. Inpro: www.inprocorp.com.
 - e. Mohawk Sign Systems, Inc: www.mohawksign.com.
 - f. Seton Identification Products: www.seton.com/aec.
 - 2. Dimensional Letter Signs:
 - a. Cosco Industries: www.coscoarchitecturalsigns.com.
 - b. FASTSIGNS: www.fastsigns.com.
 - c. Inpro: www.inprocorp.com.
 - 3. Plaques:
 - a. Cosco Industries www.coscoarchitecturalsigns.com.
 - b. FASTSIGNS: www.fastsigns.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards, California Building Code (CBC), Florida Accessibility Code for Building Construction, and Texas Accessibility Standards (TAS) and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.

3. Character Height: 1 inch (25 mm).
 4. Sign Height: 2 inches (50 mm), unless otherwise indicated.
 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Exterior Door Numbering: Provide numbering of exterior doors in compliance with 19 TAC 61.1031 and ICC (IFC) Section 505.
1. Fabrication:
 - a. Material: Retro-reflective vinyl characters applied to door system.
 - 1) Vinyl Basis of Design Product:
 - (a) Scotchlite Removable Deflective Graphic Film manufactured by 3M.
 - b. Characters: Arabic numerals or standard English alphabetical letters.
 - c. Font: Arial or similar sans serif.
 - d. Height: As indicated on Drawings, 4 inches (102 mm) minimum.
 - e. Stroke Width: 1/2 inch (12.7 mm), minimum.
 - f. Color: Black or White to contrast with background color.
 2. Locations: At all exterior doors and overhead doors. Front door to be labeled 1 and numbering will continue around the building clockwise.

2.3 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
 2. Corners: Square.
 3. Frame Finish: Natural (clear) anodized.
 4. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
 5. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
 2. Character Case: Upper case only.
 3. Background Color: Clear.
 4. Character Color: Contrasting color.

2.4 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/16 inch (1.6 mm).
- B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
1. Total Thickness: 1/8 inch (3 mm).
- C. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
1. Total Thickness: 1/8 inch (3 mm).
 2. Letter Thickness: 1/8 inch (3 mm).
 3. Letter Edges: Square.

2.5 PLAQUES

- A. Metal Plaques:
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch (3 mm), minimum.
 - 3. Size: As indicated on drawings.
 - 4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 - c. Character Color: Contrast with background color.
 - 5. Border Style: As indicated on drawings.
 - 6. Background Texture: Ripple.
 - 7. Surface Finish: Brushed, satin.
 - 8. Painted Background Color: Light oxide stain.
 - 9. Protective Coating: Manufacturer's standard clear coating.
 - 10. Mounting: Rosettes and toggle bolts.
 - a. Rosette Style: Floral.
 - b. Rosette Diameter: 3/8 inch (10 mm).

2.6 DIMENSIONAL LETTERS

- A. Metal Letters:
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch minimum (3 mm).
 - 3. Letter Height: As indicated on Drawings.
 - 4. Text and Typeface:
 - a. Character Font: Arial.
 - b. Character Case: Upper case only.
 - 5. Finish: Brushed, satin.
 - 6. Mounting: Tape adhesive.
 - 7. Lighting:
- B. Plastic Letters:
 - 1. Material: Injection molded plastic.
 - 2. Color: As selected by Architect.
 - 3. Mounting: Tape adhesive.

2.7 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Chrome plated.
- C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Where signage is adhered to glazing and will be visible from the opposite side, provide a cover plate to obscure back of signage. Furnish and install cover in material, shape, and size to match signage.

- C. Install neatly, with horizontal edges level.
- D. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- E. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION 10 14 00

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SECTION 10 21 13.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal and vestibule screens.

1.2 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.
- B. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
- C. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- D. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.
- E. Section 10 28 19 - Tub and Shower Enclosures: Shower compartment construction.

1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 6 by 6 inches (150 by 150 mm) in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Solid Plastic Toilet Compartments:
 - a. ASI Accurate Partitions: www.asi-accuratepartitions.com/#sle.
 - b. ASI Global Partitions: www.asi-globalpartitions.com/#sle.
 - c. Scranton Products: www.scrantonproducts.com/#sle.
 - d. Bobrick.
 - e. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted, headrail-braced.
 - 1. Basis of Design: Hiney Hiders as manufactured by Scranton.
 - 2. Color: Charcoal Gray.
 - 3. Texture: Orange Peel.
 - 4. Colors: Color as selected for doors, color as selected for panels.
 - 5. Doors:
 - a. Thickness: 1 inch (25 mm).
 - b. Width: 24 inch (610 mm).
 - c. Width for Wheelchair Accessible Compartments: 36 inch (915 mm), out-swinging.
 - d. Height: 55 inch (1397 mm).
 - 6. Panels:
 - a. Thickness: 1 inch (25 mm).
 - b. Height: 55 inch (1397 mm).
 - c. Width: As indicated on Drawings.
 - 7. Pilasters:
 - a. Thickness: 1 inch (25 mm).
 - b. Width: 8 inch minimum.
 - 8. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.
 - 9. Urinal Screens: Required to be floor braced with a 8 inch wide mindinium floor mounted pilaster.

2.3 ACCESSORIES

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches (76 mm) high; concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
 - 2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- B. Wall Mounting: Double Ear continious bracket with 2.5 inch legs in aluminum, internal brackets either two ear continuous or L bracket continuous with 2.5 inch legs in aluminum bolting hardware shall be tamper resistant 316 stainless.
- C. Head Rails: Extruded aluminum, anti-grip profile.
 - 1. Size: Manufacturer's standard size.
- D. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.
- E. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.
- F. Hinges: Stainless steel, manufacturer's standard finish.
 - 1. Heavy Duty piano style stainless steel with spring return. Minimum 14 guage with 1/4 inch pin.
 - 2. Continuous-type hinge, self closing.
- G. Door Hardware: Stainless steel, manufacturer's standard finish.
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Nylon bearings.
 - 3. Door Latch: Slide type with exterior emergency access feature.
 - 4. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
 - 5. Provide door pull for outswinging doors.

6. Coat Hook: Refer to Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

H. Toilet Partition Suspension Members: Refer to Section 05 50 00 - Metal Fabrications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets.
- E. Locate head rail joints at pilaster center lines.
- F. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 10 21 13.19

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SECTION 10 21 23 - CUBICLE CURTAINS AND TRACK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended, overhead curtain track and guides.
- B. Surface-mounted, overhead curtain track and guides.
- C. Cubicle curtains.

1.2 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Above ceiling track supports.
- B. Section 06 10 00 - Rough Carpentry: Above ceiling blocking and track supports for track.
- C. Section 09 51 00 - Acoustical Ceilings: Suspended ceiling system to support track.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 by 12 inch (300 by 300 mm) sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.
- E. Samples: Submit 12 inch (300 mm) sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.
- F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- G. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Curtains: Two of each type and size.
 - 3. Extra Carriers: Ten.

1.5 MOCK-UP

- A. Provide full sized installed mock up, with curtain track, curtain, cords and accessories.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. A.R. Nelson Co.
 - 2. Arc-Com.
 - 3. General Cubicle Co.
 - 4. Imperial Fastener Co., Inc.
 - 5. Inpro.
 - 6. Kirsh.
 - 7. Waltrous, Inc.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 TRACKS AND TRACK COMPONENTS

- A. Tracks: Extruded aluminum sections; one piece per track run.
 - 1. Profile: Channel.
 - 2. Mounting: Surface.
 - 3. Structural Performance: Capable of supporting vertical test load of 50 lbs (23 kg) without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 - 4. Track End Stop: To fit track section.
 - 5. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
 - 6. Suspension Rods: Tubular aluminum sections, sized to support design loads and designed to receive attachment from track and ceiling support.
 - 7. Escutcheons: Where suspension rod meets finished ceiling or structure, provide escutcheons to match rod finish.
 - 8. Finish on Exposed Surfaces: Clear anodized.
 - 9. Products:
 - a. 1200T by AR Nelson or Similar.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
 - 1. Provide ___ carriers per foot of track length (___ carriers per meter of track length)
- C. Wand: Aluminum, attached to lead carrier, for pull-to-close action.
- D. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.3 CURTAINS

- A. Cubicle Curtains:
 - 1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - 2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
 - 3. Material: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
 - 4. Color/Pattern: Refer to Drawings.
 - 5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.
 - 6. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.

B. Curtain Fabrication:

1. Width of curtain to be 10 percent wider than opening with flat panel.
2. Length of curtain to end 15 inches (380 mm) above finished floor.
3. Railroad fabric without vertical seams.
4. Pattern match fabric with vertical seams.
5. Include open mesh cloth at top 20 inches (508 mm) of curtain for room air circulation, attached to curtain as specified above.
6. Curtain Heading: Web reinforced band of open mesh cloth 20 inches at top with metal grommet holes for carriers spaced 6 inches (150 mm) on center .
7. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install curtain track to be secure, rigid, and true.
- B. Refer to Section 05 50 00 - Metal Fabrications for track supports above ceiling.
- C. Refer to Section 06 10 00 - Rough Carpentry for blocking and track supports above ceiling.
- D. Secure track to ceiling system.
- E. Install end cap and stop device.
- F. Install curtains on carriers ensuring smooth operation.

END OF SECTION 10 21 23

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SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bumper rails.
 - 2. Corner guards.
 - 3. Protective wall covering.
- B. Related Requirements:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.
 - 2. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.
 - 3. Section 09 72 00 - Wall Coverings: Terminating wall covering at wall and door protection.

1.3 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- D. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two sections of corner guards, bumper rails, and protective corridor handrails, 24 inches (610 mm) long.
 - 2. Submit two samples of protective wall covering and door surface protection, 6 by 6 inches (152 by 152 mm) square.
- E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures or internal connection failures.
 - b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.
- C. Installer Warranty: Provide 5-year warranty for metal crash rails commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.
 - 1. Failures include, but are not limited to, the following:
 - a. Detachment of rail system from substrate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Bumper Rails and Corner Guards:
 - a. Babcock-Davis: www.babcockdavis.com/#sle.
 - b. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - c. Inpro: www.inprocorp.com/#sle.
 - d. Koroseal Interior Products: www.koroseal.com/#sle.
 - e. Nystrom, Inc: www.nystrom.com/#sle.
 - 2. Protective Wall Covering:
 - a. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - b. Inpro: www.inprocorp.com/#sle.
 - c. MDC Interior Solutions: www.mdcwall.com/#sle.
 - d. Pawling Corp: www.pawling.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.

- C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.3 PRODUCT TYPES

- A. Bumper Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
1. Basis of Design: 1600 Wall Guard as manufactured by Inpro Corp.
 2. Performance of Installed Assembly:
 - a. Support vertical live load of 100 lb/linear ft (1,400 N/m) with deflection not to exceed 1/50 of span between supports.
 - b. Resist lateral force of 250 lbs (1112 N) at any point without damage or permanent set.
 3. Material: High impact Rigid vinyl, color as selected from manufacturer's standard colors.
 4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 5. Mounting: Surface.
 6. Height: 6 inches.
 7. Depth: 1 inch.
 8. Color: Ozark.
- B. Corner Guards - Surface Mounted, High-Impact Vinyl:
1. Basis of Design: Corner Guards - 130 manufactured by Inpro Corp.
 2. Material: High impact vinyl with full height extruded aluminum retainer.
 3. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 5. Width of Wings: 3 inches.
 6. Corner: 1-1/4 inch radius.
 7. Height: 8 feet or as indicated on Drawings.
 8. Color: 0140 Antique White for PT-1 Shoji White.
 9. Length: One piece, 48 inches (1219 mm).
 10. Preformed end caps.
 11. Mounting: Continuous aluminum retainer with countersunk holes.
- C. Protective Wall Covering:
1. Basis of Design: Ozark as manufactured by Acrovyn.
 2. Thickness: 0.040 inch (1.02 mm).
 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 4. Color: As selected by Architect from manufacturer's standard finishes.
 5. Color matching outside corner and trims.
 6. Pattern: None.
 7. Texture: Suede.
 - a. Texture Direction: Horizontal.
 8. Mounting: Direct glued to wall.

2.4 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

2.5 SOURCE QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.2 INSTALLATION

- A. Position top of bumper rail 36 inches (914 mm) from finished floor.
- B. Terminate rails 1 inch (25.4 mm) short of door openings and intersecting walls.
- C. Position protective wall covering no less than 1 inch (25.4 mm) above finished floor to allow for floor level variation.
 - 1. Apply adhesive with 1/8 inch (3.2 mm) V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.

3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.4 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 10 26 00

SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Washroom accessories.
 - 2. Toilet accessories.
 - 3. Shower room accessories.
 - 4. Warm air dryers.
 - 5. Childcare accessories.
 - 6. Custodial accessories.
 - 7. Accessories necessary for a complete installation.

1.2 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
- C. ASTM F446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 2019.
- D. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 PERFORMANCE REQUIREMENTS

- A. Grab Bars:
 - 1. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:

1.4 SUBMITTALS

- A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 2. Include electrical characteristics.
- B. Samples: Provide a sample to demonstrate each exposed product finish specified.
- C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.
- D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Source Limitations: Obtain products from single source from single manufacturer.

1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.7 WARRANTY

- A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. AJW Architectural Products.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. Brey-Krause Manufacturing Co.
 - 6. Dyson.
 - 7. GAMCO Specialty Accessories; a division of Bobrick.
 - 8. Georgia Pacific.
 - 9. Tubular Specialties Manufacturing, Inc.
- B. Substitutions: Refer to 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Stainless Steel: ASTM A666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated
- B. Mirrors: ASTM C1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick

2.3 COMPONENTS

- A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 1. Material and Finish: Antimicrobial, molded plastic, white

2.4 FABRICATION

- A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 SCHEDULE

4.1 TOILET ACCESSORY SCHEDULE

- A. TA-1C - Soap Dispensers – Counter-Mounted:
 - 1. NOT USED.
- B. TA-1W - Soap Dispensers – Wall-Mounted: OFCI
- C. TA-2 - Lavatory Mirrors, Typical:
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-290.
 - 3. Size: Refer to Drawings.
 - 4. Location: Where indicated on Drawings.
- D. TA-2F - Full-Length Mirrors:
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-290.
 - 3. Size: 24 inches by 72 inches.
 - 4. Location: Where indicated on Drawings.
- E. TA-3 - Toilet Paper Dispensers: OFCI.
- F. TA-4 - Paper Towel Dispensers: OFCI
- G. TA-5 - Grab Bars: (At Wheelchair-Accessible Water Closets):
 - 1. Size/Finish: 1-1/2 inch diameter satin stainless steel.
 - 2. Basis of Design: Bobrick B-6806.
 - 3. Mounting: Attach with concealed mounting kit. Mount parallel to floor.
 - 4. Location: At each wheelchair-accessible water closet.
- H. TA-6 - Sanitary Napkin Dispensers: OFCI.
- I. TA-7 - Sanitary Napkin Disposal:
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-270.
 - 3. Locations: Where indicated on Drawings.
- J. TA-8 - Shelf with Mop and Broom Holders and Hooks:
 - 1. Mounting: Surface.
 - 2. Model No.: B-239 x 34.
 - 3. Capacity: Four hooks, three mop holders.
 - 4. Locations: Mop sink at each custodial rooms.
- K. TA-9 - Grab Bars: (At Accessible Shower):
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-6861 modified (24 x 16).

3. Locations: At each accessible shower stall.
- L. TA-10A - Folding Benches: Adult Height:
 1. Mounting: Surface, reversible.
 2. Basis of Design: Bobrick B-5181.
 3. Locations: Where indicated on Drawings.
- M. TA-10C - Folding Benches, Child Height (15 inches (375 mm) seat height):
 1. NOT USED.
- N. TA-11 - Clothing Hook:
 1. Mounting: Surface.
 2. Basis of Design: Bobrick B-6717.
 3. Locations: All shower locations.
 4. Toilet and Shower Partitions: If toilet and shower partitions are utilized, hooks are to be provided by the partition manufacturer(s) as part of their hardware package.
- O. TA-12 - Shower Curtains, Rods and Hooks:
 1. Basis of Design:
 - a. Rods: Bobrick B-6107 (36 inches or as indicated).
 - b. Curtains: Bobrick B-204-2 (42 inches x 72 inches or as required).
 - c. Hooks: Bobrick B-204-1.
 2. Mounting/Locations: Where indicated on Drawings.
- P. TA-13 - Electric Hand Dryers:
 1. Mounting: Surface.
 2. Basis of Design: Airblade V by Dyson.
 3. Voltage: 200-240 volt, 50&60 Hz.
 4. Location: Where indicated on Drawings.
- Q. TA-14 - Paper Towel Dispenser/Trash Receptacle Combination:
 1. Mounting: Surface.
 2. Basis of Design: Bobrick B-3949.
 3. Locations: Where indicated on Drawings.
- R. TA-15 - Grab Bars: (At Ambulatory-Accessible Toilet Compartments):
 1. Size/Finish: 1-1/2 inch diameter satin stainless steel, lengths as indicated in drawings.
 2. Basis of Design: Bobrick B-6806.
 3. Mounting: Attach with concealed mounting. Mount parallel to floor.
 4. Location: At each ambulatory-accessible toilet compartment.
- S. TA-16 - Baby Changing Station:
 1. Type: Horizontal station to accommodate infants and toddlers.
 2. Basis of Design:
 - a. Model KB200 manufactured by Koala Kare Products, a division of Bobrick.
 3. General Requirements:
 - a. Comply with applicable accessibility and regulatory requirements..
 - b. Comply with with ASTM F2285.
 - c. Provide universal instruction graphics and safety messages in multiple languages.
 - d. Provide replaceable restraining straps.
 4. Construction and Features:
 - a. Dimensions: 35 inches long by 22 inches high by 4 inches deep.
 - b. FDA approved injection molded polypropylene with steel on steel hinge system. Fabricate to withstand static loads over 400 pounds.
 - c. Child protection straps with snap lock fasteners.
 - d. Built-in diaper bag hooks.

- e. Built-in sanitary liner dispensers; 3 ply, biodegradable.
 - f. Premium gas spring mechanism.
 - g. Molded usage and safety instructions in six languages and Braille.
 - h. Comply with applicable accessibility regulations.
 - i. Antifungal to comply with ASTM standards.
- 5. Color: As selected by Architect from manufacturer's full line.
- 6. Finish: Manufacturer's standard stainless steel.
- 7. Location: Where indicated on Drawings.
- T. TA-16A - Adult Changing Station:
 - 1. NOT USED.
- U. TA-17R - Trash Receptacle, Recessed:
 - 1. NOT USED.
- V. TA-17U - Trash Receptacle Undercounter:
 - 1. NOT USED.
- W. TA-18 - Vertical Grab Bar:
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-6806x18.
 - 3. Locations: As indicated on Drawings.
- X. TA-19 – Water Closet Cover Dispenser:
 - 1. NOT USED.
- Y. TA-20 - Folding Utility Shelf:
 - 1. NOT USED.
- Z. TA-21 - Hand Sanitizer:
 - 1. NOT USED.
- AA. TA-22 - Pass Through Specimen Cabinet:
 - 1. Basis of Design: Bradley Model 9813.
 - 2. Locations: As indicated on Drawings.

END OF SECTION 10 28 00

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SECTION 10 43 00 - EMERGENCY AID SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Automated external defibrillators (AEDs).
- B. Automated external defibrillator (AED) cabinets.
- C. Key boxes.
- D. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 DEFINITIONS

- A. Automated External Defibrillator (AED): A Food and Drug Administration (FDA)-approved portable device, which automatically analyzes the heart rhythm and recognizes the presence of ventricular fibrillation and/or tachycardia. If defibrillation is warranted, the AED automatically charges and prompts (visual and/or audio) the operator to deliver an electrical shock.

1.4 REFERENCE STANDARDS

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test schedules and recertification requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Automated External Defibrillators (AEDs):
 - a. Philips Medical Systems: www.usa.philips.com.
 - b. Stryker Corporation: www.stryker.com.
 - c. ZOLL Medical Corporation: www.zoll.com.
 - d. JL Industries.
 - 2. Emergency Aid Cabinets and Accessories:
 - a. Activar Construction Products Group, Inc. - JL Industries; LifeStart 1400 Series AED Cabinet: www.activarcpg.com/#sle.
 - b. Modern Metal Products, a division of Technico, Inc: www.modern-metal.com/#sle.
 - 3. Key Boxes:
 - a. Knox Company: www.knoxbox.com/#sle.
 - 4. AED Floor Marking Kits:
 - a. Insite Solutions, LLC: www.stop-painting.com/#sle.

2.2 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)

- A. Automated External Defibrillators (AEDs) - General: FDA approval required.
 - 1. Provide automated external defibrillators (AEDs) as indicated.
 - a. Basis of Design:
 - 2. Automated external defibrillators (AEDs) shall be provided by Owner.

2.3 EMERGENCY AID CABINETS

- A. Type: Automated external defibrillator (AED).
- B. Basis of Design: Model 1436F12 Semi-Recessed Cabinet as manufactured by JL Industries.
- C. Cabinet Construction: Non-fire-rated.
- D. Cabinet Configuration: Semi-recessed type as indicated on Drawings..
 - 1. Size each cabinet to accommodate AED as indicated on Drawings.
 - 2. Trim:
 - a. Projected Trim at Semi-Recessed: Returned to wall surface, with 1-1/2 inch square trim.
 - 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- E. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with wire pull handle and nylon catch. Hinge door for 180 degree opening with two butt hinges.
- F. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- H. Fabrication: Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- J. Finish of Door Pull or Handle: Stainless steel.
- K. Finish of Cabinet Interior: White powder coat.

2.4 KEY BOXES

- A. Basis of Design: 3200 Series manufactured by Knox Company.
- B. Mounting: Fully-recessed, as indicated on drawings. Surface mounted units are not acceptable.
- C. Finish: Black.

2.5 ACCESSORIES

- A. Cabinet Door Signage: "AED" decal, as required, or vinyl self-adhering, prespaced black lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).
- B. AED Floor Marking Kits:
 - 1. Floor Marking Tape for AED Access Identification: Self-adhesive vinyl or polyester tape with overlamine, 2 inches (51 mm) wide, with "DO NOT BLOCK" on the 36 inch (914 mm) side strips and "AED" and AED icon on the 24 inch (610 mm) middle strip.
 - 2. Floor Sign: 17-1/2 inch (445 mm) diameter vinyl sign with "AED" and AED icon.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. AED Installation:

1. Install in accordance with manufacturer's instructions.
- B. Cabinet Lettering:
 1. Location: Face of door framing.
- C. Key Box Installation:
 1. Install in accordance with manufacturer's instructions.
 2. Location: As indicated on Drawings or as directed by Authorities Having Jurisdiction (AHJ).

3.3 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors to operate smoothly without binding.
- C. On completion of installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes. Replace products that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

END OF SECTION 10 43 00

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SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire extinguishers.
 - 2. Fire blankets.
 - 3. Fire extinguisher cabinets.
 - 4. Accessories.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
 - 2. Section 09 90 00 - Painting and Coating: Field paint finish.

1.2 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.4 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Fire Extinguishers:
 - a. Ansul, a brand of Tyco Fire Protection Products, a division of Johnson Controls International: www.ansul.com/#sle.
 - b. JL Industries, an Activar Construction Products Group, Inc. brand: www.activarcpg.com/#sle.

- c. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
- d. Nystrom, Inc: www.nystrom.com/#sle.
- e. Oval Fire Products: www.ovalfireproducts.com/#sle.
- f. Potter-Roemer, a member of Morris Group International: www.potterroemer.com/#sle.
- g. Pyro-Chem, a division of Johnson Controls International: www.pyrochem.com/#sle.
- 2. Fire Extinguisher Cabinets and Accessories:
 - a. JL Industries, an Activar Construction Products Group, Inc. brand: www.activarcpg.com/#sle.
 - b. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - c. Larsen's Manufacturing Co., a member of Morris Group International: www.larsensmfg.com/#sle.
 - d. Nystrom, Inc: www.nystrom.com.
 - e. Oval Fire Products: www.ovalfireproducts.com.
 - f. Potter-Roemer, a member of Morris Group International: www.potterroemer.com/#sle.

2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Basis of Design: Cosmic 10E manufactured by JL Industries.
 - 2. Stored Pressure Operated: Deep Drawn.
 - 3. Class: A:B:C type.
 - 4. Size: 10 pound (4.54 kg).
 - 5. Finish: Baked polyester powder coat, red color.
 - 6. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to 120 degrees F (49 degrees C).
- C. Wet Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
 - 1. Class: K type.
 - 2. Size: 1.6 gallons (6 L).
 - 3. Finish: Polished stainless steel.
 - 4. Temperature range: Minus 20 degrees F (Minus 29 degrees C) to 120 degrees F (49 degrees C).

2.3 FIRE EXTINGUISHER CABINETS

- A. Existing fire extinguisher cabinet for reuse:
 - 1. Verify fire extinguisher cabinet is in good working order prior to installation. If not, notify Owner.
- B. General:
 - 1. Basis of Design: Comopolitan Series - Stainless Steel as manufactured by JL Industries.
 - 2. Size to accommodate indicated extinguisher and accessories.
 - 3. Doors:
 - a. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
 - 4. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
 - 5. Fabrication: Weld, fill, and grind components smooth.
 - 6. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
 - 7. Finish of Cabinet Interior: White enamel.
 - 8. Include Do Panel with Saf-t-Lock.

- C. Semi-RecessStandard Cabinet Construction:
 - 1. Non-fire-resistance-rated, two 1/2 inch ADA compliant.
 - 2. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
 - 3. Formed aluminum; 0.040 thick base metal.
- D. Cabinet Configuration: Partially-Recessed.
 - 1. Trim: Flat square edge, with 1-1/2 lwide face.

2.4 FIRE BLANKET CABINET

- A. Drop-Type Fire Blanket Cabinet
 - 1. Basis of Design: Royal Series Model 9613S21 as manufactured by J.L. Industries.
 - 2. Cabinet:
 - a. Material: Metal tub and door painted with red epoxy paint and white vinyl letters indicating "FIRE BLANKET". Hardware to be zinc-plated.
 - b. Mounting: Surface
- B. Roller-Type Fire Blanket Cabinet:
 - 1. Basis of Design: Royal Series Model 9519S21 as manufactured by J.L. Industries.
 - 2. Cabinet:
 - a. Material: Metal tub and door painted with red epoxy paint and white vinyl letters indicating "FIRE BLANKET". Hardware to be zinc-plated.
 - b. Mounting: Surface.

2.5 ACCESSORIES

- A. Fire Blanket: Fire retardant treated wool; red, 62 by 84 inch (1575 by 2135 mm) size complying with 16 CFR 1610..
- B. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Locate as indicated on Drawings, as directed by the Owner, and as follows:
 - 1. Provide a minimum of one Multipurpose Fire Extinguisher for each 6,000 sq. ft (557 sq. m), or part thereof, in the project scope, per NFPA 10 Table 6.2.1.1 or as indicated on Drawings, whichever is greater.
 - 2. Provide one Multipurpose Fire Extinguisher with wall bracket in each of the following locations:
 - a. Mechanical Rooms.
 - b. Electrical Rooms.
 - c. MDF/IDF/Telecommunications Rooms.
 - d. Fire Riser Rooms.
 - e. Auditoriums of 4000 square feet or less.
- B. Install in accordance with manufacturer's instructions.
- C. Install cabinets plumb and level in wall openings, such that it complies with accessibility requirements.
- D. Secure rigidly in place.
- E. Place extinguishers in cabinets.
- F. Position cabinet signage at coordinated location with Architect and Owner.

3.3 MAINTENANCE

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION 10 44 00

SECTION 10 51 13 - METAL LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal lockers.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.
- B. Section 06 10 00 - Rough Carpentry: Wood base construction.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.
- D. Section 06 20 00 - Finish Carpentry: Bench tops for locker bench support brackets.

1.3 REFERENCE STANDARDS

- A. {RSTEMP#undefined}
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- F. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
 - 1. Wired Access Control: Include power requirements and standard wiring diagrams for specified products.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
 - 1. Wired Access Control: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
- D. Full Size Sample: One full-size locker of each construction specified for evaluation of construction.
- E. Samples: Submit two samples 3 by 6 inches (75 by 150 mm) in size showing color and finish of metal locker material.
- F. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Art Metal Products: www.artmetalproducts.com.

2. ASI Storage Solutions: www.asi-storage.com.
 3. DeBourgh Manufacturing Co: www.debourgh.com.
 4. List Industries, Inc: www.listindustries.com.
 5. Lockers MFG: www.lockersmfg.com.
 6. Lyon Workspace Products: www.lyonworkspace.com.
 7. Republic Storage Systems Co: www.republicstorage.com.
 8. Tennsco Storage: www.tennsco.com.
 9. WEC Manufacturing: www.itswec.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 LOCKER APPLICATIONS

- A. Student Lockers(SWL): Metal lockers, wall mounted for base indicated on Drawings.
1. Basis of Design: Heavy Duty Ventilated manufactured by List Industries .
 2. Width: 15 inches (381 mm).
 3. Depth: 15 inches (381 mm).
 4. Height: 72 inches (1830 mm).
 5. Configuration: Two tier.
 6. Ventilation: Louvers at top and bottom of door panel.
 7. Locking: Padlock hasps, for padlocks provided by Owner.
 - a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
 8. Color: To be selected from manufacturer's full range by Architect.
- B. Athletic Lockers(AL1): Metal lockers, free-standing with matching closed base.
1. Basis of Design: All Star manufactured by List Industries.
 2. Width: 24 inches (610 mm).
 3. Depth: 18 inches (457 mm).
 4. Height: 72 inches (1830 mm).
 5. Configuration: Single tier.
 6. Fittings: Size and configuration as indicated on drawings.
 - a. Upper shelf.
 - b. Coat rod.
 - c. Hooks: One single prong.
 - d. Lower shelf/seat.
 - e. Single shoe shelf.
 7. Ventilation: Perforated side panels and doors.
 8. Locking: Padlock hasps, for padlocks provided by Owner.
 - a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
 9. Provide sloped top.
 10. Color: To be selected from manufacturer's full range by Architect.
- C. Athletic Lockers (AL2): Metal lockers, free-standing for base indicated on Drawings.
1. Basis of Design: Athletic Team Lockers manufactured by List Industries.
 2. Width: 18 inches (457 mm).
 3. Depth: 18 inches (457 mm).
 4. Height: 72 inches (1823 mm).
 5. Configuration: Two Tier.
 6. Fittings: Size and configuration as indicated on drawings.

- a. _____
- 7. Ventilation: Manufacturer's standard louvers in door panel.
- 8. Locking: Padlock hasps, for padlocks provided by Owner.
- 9. Provide sloped top.
- 10. Color: To be selected from manufacturer's full range by Architect.
- D. Athletic Lockers (AL3): Metal lockers, free-standing for base indicated on Drawings.
 - 1. Basis of Design: Athletic Team Lockers manufactured by List Industries.
 - 2. Width: 15 inches.
 - 3. Depth: 18 inches.
 - 4. Height: 72 inches.
 - 5. Configuration: Three Tier.
 - 6. Fittings: Size and configuration as indicated on drawings.
 - 7. Ventilation: Manufacturer's standard louvers in door panel.
 - 8. Locking: Padlock hasps, for padlocks provided by Owner.
 - 9. Color: To be selected from manufacturer's full range by Architect.
- E. Athletic Lockers (AL5): Metal lockers, free-standing for base indicated on Drawings.
 - 1. Basis of Design: P.E. Series Lockers manufactured by List Industries.
 - 2. Width: 12 inches.
 - 3. Depth: 12 inches.
 - 4. Height: 60 inches.
 - 5. Configuration: Five Tier.
 - 6. Fittings: Size and configuration as indicated on drawings.
 - 7. Locking: Padlock hasps, for padlocks provided by Owner.
 - 8. Color: To be selected from manufacturer's full range by Architect.

2.3 METAL LOCKERS

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- B. Locker Case Construction:
 - 1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
 - a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
 - b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
 - 1) Perforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
 - (a) Uncoated.
 - (b) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
 - (c) Zinc-Iron-Alloy-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation A40/ZF120.
 - (d) Zinc-Coated by the Electrolytic Process: Comply with ASTM A879/A879M, coating designation 30Z.
 - (e) Perforations: Manufacturer's standard pattern of square holes.
 - 2) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
 - (a) Class 1, uncoated.
 - (b) Class 2, hot-dip zinc-coated, galvanized or galvanized.
 - 3) Body and Shelves: 16 gauge, 0.0598 inch (1.52 mm).

- 4) Backs: 18 gauge, 0.0478 inch (1.21 mm).
 - 5) Base: 18 gauge, 0.0478 inch (1.21 mm).
 - (a) Height: 4 inches (100 mm).
 - 6) Legs: Manufacturer's standard
 - (a) Form by extending frame members.
 - (b) Fabricate from 14 gauge, 0.0747 inch (1.90 mm) nominal thickness steel sheet specified above, welded to bottom of locker.
 - (c) Height: 6 inches (152 mm).
 - c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
 - d. Where ends or sides are exposed, provide flush panel closures.
 - e. Provide filler strips where indicated or required, securely attached to lockers.
- C. Drawer Base with Bench:
1. Top, Bottom, Sides, Back, and Drawer: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.
 2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.
 3. Integral self latching mechanism triggered by operation of wardrobe door.
 4. Bench: Mixed hardwood.
- D. Latches and Door Handles: Manufacturer's standard.
1. Latching Components: 300 Series Stainless Steel (ASTM A240/A240M).
 2. Latching: Manufacturer's standard for locking arrangement selected.
 - a. Three-Point Lift Handle Gravity Latch: Pocket-mounted, provide for doors 18 inches (457 mm) or taller.
 - 1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.
 - 2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.
 - (a) Padlock Eye: Integral with lift trigger, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
 - 3) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
 - 4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
 - 5) Rubber bumpers riveted to door stops for silent operation.
 - b. Three-Point Pull Handle Gravity Latch: Surface-mounted, provide for doors 18 inches (457 mm) or taller.
 - 1) Handle: Steel finger lift mechanism.
 - 2) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
 - 3) Padlock Eye: Integral with lift handle, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
 - 4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
 - 5) Rubber bumpers riveted to door stops for silent operation.
 - c. Three-Point/Three-Sided Cremone Latch.
 - 1) Latching mechanism operated by a steel handle welded to a three-point Cremone-type assembly.
 - 2) Latching rods, 3/8 inch (9.5 mm) diameter, engage top and bottom edge of locker frame. 3/16 inch (4.8 mm) thick center latch engages door jamb.
 - d. Single-Point Latch: Provide for doors indicated.

- 1) Stationary latch welded securely to locker frame.
- 2) Latch extends no more than 1-1/4 inch (31.8 mm) into locker opening, penetrating through cup.
- 3) Flush-mounted, recessed stainless steel cup in a formed door with 18 gauge, 0.0478 inch (1.21 mm) vertical back panel stiffener.
- e. Spring Latch: Provide for box-size lockers and where indicated.
 - 1) 16 gauge, 0.0598 inch (1.52 mm) cold rolled steel, zinc plated with a 10 gauge, 0.1345 inch (3.42 mm) latch and 16 gauge, 0.0598 inch (1.52 mm) stainless steel lock hasp and completely enclosed stainless steel spring.
 - 2) Assembled using six nickel-plated rivets.
 - 3) Equip box locker doors with a padlock hasp and a stainless steel strike plate with an integral handle pull. Box locker doors may also be equipped with built-in locks.
- f. Access Control Single-Point Latch: Provide for doors indicated.
 - 1) Wireless integrated access control locking devices.
 - 2) Stationary latch welded securely to locker frame.
 - 3) Rubber bumpers riveted to door stops for silent operation.
- E. Cup, Pocket: Manufacturer's standard, with integral pull, and recessed surface punched for installation of lock, latch lift mechanism, and number plate.
- F. Hinges: Continuous piano hinge with powder coat finish to match locker color.
- G. Hinges: Heavy-duty, 7-knuckle type; two for doors under 42 inches (1050 mm) high; three for doors over 42 inches (1 050 mm) high.
- H. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.
- I. Trim: 20 gauge, 0.0359 inch (0.91 mm).
- J. Coat Hooks: Stainless steel or zinc-plated steel.
- K. Number Plates: Provide rectangular shaped aluminum plates. Form numbers 1 inch high of block font style with ADA designation, in contrasting color.
- L. Locks: Locker manufacturer's standard type indicated in Applications article above.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.
- C. Verify that power and ethernet are installed and enabled. See manufacturer drawings for recommended outlet or junction box placement.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and sloped tops.
- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 51 13

SECTION 10 73 16.13 - METAL CANOPIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Freestanding, shop-fabricated metal canopies.
 - 2. Accessories necessary for a complete application.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete footings.

1.3 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- D. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
- E. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- G. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings; 2020.
- K. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
- L. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- M. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- N. ASTM E2950 - Standard Specification for Metal Canopy Systems; 2014 (Reapproved 2020).
- O. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.
- P. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.

- Q. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- R. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
- C. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, and fastening details.
- D. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer.
- E. Designer's Qualification Statement.
- F. Manufacturer's Qualification Statement.
- G. Erector's Qualification Statement.
- H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
 - 1. Comply with applicable code for submission of design calculations as required for acquiring permits.
 - 2. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
- B. Perform work in accordance with AISC 303.
 - 1. Maintain one copy on site.
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Not less than three years of documented experience.
- D. Erector Qualifications: Company specializing in performing the work of this section.
 - 1. Not less than three years of documented experience and approved by canopy manufacturer.
- E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site ready for erection.
- B. Package using methods that prevent damage during shipping and storage on site.
- C. Store materials under cover and elevated above grade.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Metal Canopies: Correct defective work within a two year period after Date of Substantial Completion.

- C. Finish Warranty: Provide manufacturer's one year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Aluminum Systems:
 - a. Aluminum Techniques, Inc.: www.aluminumtechniques.com.
 - b. AVAdek, Inc.: www.avadek.com.
 - c. Duo-Gard Industries, Inc.: www.duo-gard.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 SHOP FABRICATED ALUMINUM CANOPIES

- A. Basis of Design:
 - 1. Products manufactured by Aluminum Techniques, Inc, AVAdek, Inc, or Duo-Gard Industries, Inc.
- B. Pre-engineered system complying with ASTM E2950.
- C. Design and fabricate metal canopy system to resist wind, snow, live, and seismic loads without failure, damage, or permanent deflection in accordance with ASCE 7:
 - 1. Loads: As indicated on Drawings.
- D. Thermal Movement: Design system to accommodate thermal movement caused by ambient temperature range of 120 degrees F (49 degrees C) and surface temperature range of 180 degrees F (82 degrees C) without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
- E. Configuration: As indicated on Drawings.

2.3 COMPONENTS

- A. Aluminum:
 - 1. Sheet and Plate: ASTM B209/B209M.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221/ASTM B221M, Alloy 6063-T5/T52.
 - 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M, Alloy 6063-T6.
 - 4. Structural Profiles: ASTM B308/B308M.
 - 5. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
 - 6. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.
 - 7. Plate and Sheet: ASTM B209/B209M, Alloy 6061-T6.
 - 8. Die and Hand Forgings: ASTM B247/ASTM B247M, Alloy 6061-T6.
 - 9. Castings: ASTM B26/B26M, Alloy A356.0-T6.
- B. Anchor Bolts: ASTM A307 or ASTM A572/A572M, formed with bent shank, assembled with template for casting into concrete.
 - 1. Minimum exposed thread of 7 inches (178 mm) above footing and 23 inch (584 mm) minimum embedment.
 - 2. Provide nuts and washers as required for column leveling and plumbing.
- C. Concrete Footings: Refer to Structural for additional requirements.

2.4 SHOP FABRICATION

- A. Provide a complete system ready for erection at project site.

- B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
- C. Perform welding in accordance with AWS D1.1/D1.1M.
- D. Fabricate connections for bolt, nut, and washer connectors.

2.5 FINISHES

- A. Structural Aluminum Components:
 - 1. Clear anodized finish; color to be selected by Architect from manufacturer's standard range.
- B. Steel Fascia:
 - 1. Fluoropolymer finish; color as selected from manufacturer's standard range.
- C. Steel Fascia: Locations as indicated in Drawings.

2.6 ACCESSORIES

- A. Structural Bolts: ASTM F3125/F3125M, Grade A325, minimum 3/4 inch (19 mm) diameter.
- B. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as sheet metal decking; factory-fabricated to required profiles.
 - 1. Exposed Fasteners: Not permitted.
- C. Grout: ASTM C1107/C1107M; non-shrinking; premixed compound consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents.
- D. Fasteners, Non-Structural: ASTM F593 stainless steel or ASTM A307 carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that foundation, electrical utilities, and placed anchors are in correct position.
- C. Verify that bearing surfaces are ready to receive this work.
- D. Do not proceed with installation until all conditions are satisfactory.

3.2 INSTALLATION - FRAMING

- A. Erect framing in accordance with AISC 303.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.
- D. Fasten columns to anchor bolts.
- E. Do not field cut or alter structural members without approval.
- F. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 INSTALLATION - CANOPY COVERING

- A. Install in accordance with manufacturer's instructions.
- B. Fasten metal decking to steel support members, aligned level and plumb.
- C. Install fascia panels, trim, and flashing.
- D. Separate dissimilar metals using concealed bituminous paint.
- E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.4 TOLERANCES

- A. Maximum Variation from Level: Plus/Minus 1/8 inch (3.175 mm).

3.5 CLEANING

- A. Clean surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.6 PROTECTION

- A. Protect canopy after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION 10 73 16.13

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SECTION 10 75 00 - FLAGPOLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aluminum flagpoles.
 - 2. Accessories as required for a complete installation.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete base and foundation construction.
 - 2. Section 31 23 23 - Fill: Sand to fill foundation tube sleeve.

1.3 REFERENCE STANDARDS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2024.
- B. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.
- C. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, and configurations.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.
- D. Samples: Submit illustrating pole material, color, and finish.
- E. Designer's Qualification Statement.
- F. Operation Data: Provide operating data for the controller and timer.
- G. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Texas.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Flagpoles:
 - a. Concord American Flagpole: www.concordamericanflagpole.com.
 - b. Morgan-Francis Flagpoles & Accessories: www.morgan-francis.com.

- c. Pole-Tech Co, Inc: www.poletech.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 FLAGPOLES

- A. Basis of Design Product:
 - 1. Internal - Independence manufactured by Concord American Flagpole.
- B. Flagpoles: Designed in accordance with NAAMM FP 1001
 - 1. Material: Aluminum.
 - 2. Design: Cone tapered.
 - 3. Mounting: Ground mounted type.
 - 4. Nominal Height: 35 feet (10.7 m); measured from nominal ground elevation.
 - 5. Halyard: External type, manual-crank, with lock.
 - 6. Provide two (2) aluminum swivel snaps per flag.
- C. Performance Requirements:
 - 1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.3 POLE MATERIALS

- A. Aluminum: ASTM B241/B241M, 6063 alloy, T6 temper.

2.4 ACCESSORIES

- A. Finial Ball: Aluminum, 6 inch (150 mm) diameter.
- B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
- C. Flag(s): nylon fabric, with grommets, hemmed edges.
 - 1. Size(s):
 - a. For 35 foot (10.7 m) Pole(s): 6 ft by 10 ft (1.8 m by 3.0 m).
- D. Cleats: 9 inch (230 mm) size, aluminum with stainless steel fastenings, two per halyard.
- E. Halyard: 5/16 inch (8 mm) diameter external with lock.
- F. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.
- G. Provide two (2) aluminum swivel snaps per flag.
- H. Primer: Zinc chromate type.

2.5 OPERATORS

- A. Hand Crank

2.6 MOUNTING COMPONENTS

- A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gauge, 0.0598 inch (1.52 mm) steel, galvanized, depth as indicated by Manufacturer.
- B. Pole Base Attachment: Flush; steel base with base cover.
- C. Lighting Ground Rod: 3/4 inch (19 mm) diameter copper rod, length as indicated by Manufacturer.
- D. Lighting Ground Cable: Copper No. 6 AWG, soft drawn.

2.7 FINISHING

- A. Metal Surfaces in Contact With Concrete: anodized aluminum, satin finish

- B. Aluminum: Clear anodized, satin finish.
- C. Finish: Spun finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

- A. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions.
- B. Fill foundation tube sleeve with concrete specified in Section 03 30 00.
- C. Fill foundation tube sleeve with sand specified in Section 31 23 23 and compact.
- D. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.
- E. Set brackets for wall set flagpoles anchored securely into wall construction. Seal watertight.
- F. Locate electric control box where indicated.
- G. Coordinate installation of conduit and boxes from disconnect to control unit and control unit to motor operating device.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1 inch (25 mm).

3.5 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION 10 75 00

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SECTION 11 06 00 – STAGE RIGGING EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provision and installation of all equipment as required for complete and fully operational systems. Where equipment, components, materials, hardware and/or services have been omitted from the drawings and specifications, but are required for fully functional systems, they shall be assumed to be included and shall be provided without claim for change to the Contract price.
- B. Field verification of dimensions, conditions and obstructions at the job site. Field coordination with other trades and General Contractor.
- C. Submission of shop drawings.
- D. Delivery, unloading, unpacking and removal of all related packaging and debris from the job site.
- E. Inspection, alignment, and final adjustment of completed installation, demonstration for approval and instruction for operating personnel.
- F. The System shall basically be comprised of the following:
 - 1. Broadcast studio pipe grid and hanging hardware

1.3 RELATED WORK

- A. Related work specified under other sections of the specifications:
 - 1. Structural support steel
 - 2. Electrical Systems
 - 3. Theater Electrical Systems

1.4 QUALITY ASSURANCE

- A. Work shall be done by people skilled in this trade in strict accordance with the requirements and/or specification of the manufacturers of the material being used.
- B. Qualifications:
 - 1. This Contractor shall have been an authorized representative of the manufacturers of the specified equipment and systems for a minimum of five years. This representative shall exercise engineering supervision over the complete installation. Contractor shall have been involved in stage rigging and drapery system installations for a period of ten years or more and shall have completed at least ten installations of this type and scope. The Architect shall be the final judge of suitability of experience.
 - 2. This Contractor shall maintain and operate his own shops and fabricate or assemble all components except for standard hardware, materials and equipment.
 - 3. The Architect shall have the right to inspect any previous equipment or systems as furnished or installed by this Contractor. In addition, the right is reserved by the Architect to reject a Contractor who has failed in any respect to comply with every provision of any previous contract.
- C. A single Contractor who shall be responsible for the proper installation, functioning and compatibility of system equipment shall supply equipment, including required modification. No sub-contracting of work shall be permissible.

- D. The safety parameters set forth herein are intended to reflect safeguards and precautions related not only to normal use of the equipment under ideal operating and lading conditions but, additionally, to anticipate equipment misuse, human error and misjudgment.
- E. Pursuant to the above and as “a condition precedent” for minimizing product liability claims before they occur, each bidder by signature affixed to his proposal form as an essential contract requirement attests as follows, reflecting mandates of the Consumer Product Safety Commission:
 - 1. He has not on previous stage rigging work under his contractual responsibility within the preceding ten-year period substituted case iron component for supporting or carrying static or dynamic overhead loads under stresses of tensions and/or impact where malleable iron or steel was specified for such components. The load-bearing components includes but are not limited to arbor top or bottom members and hook clamps for attaching loft or head blocks to the rigging steel.
 - 2. He has reported all such breach of contract infractions as listed above to the Consumer Product Safety Commission as required by the Act (Public Law 92-573) and has either replaced or remodeled such work or reimbursed the Owner(s) in suitable amount for allowing such replacement or remodeling being done by others and all as approved by the Commission.

1.5 REFERENCES

A. Regulatory Agencies:

- 1. American Institute of Architects
- 2. American Institute of Steel Construction
- 3. American Institute of Timber Construction
- 4. American National Standards Institute
- 5. American Welding Society
- 6. Associated Wire Rope Fabricators
- 7. Construction Specification Institute
- 8. Iron Casting Society
- 9. National Electrical Manufacturers Association
- 10. National Fire Protection Association
- 11. Underwriter's Laboratories
- 12. United States Institute of Theatre Technology
- 13. Occupational Safety and Health Act of 1970
- 14. Additional applicable codes, standards, regulations and guidelines shall be adhered to in both spirit and letter of intent.

1.6 INTERFACE WITH ADJACENT SYSTEMS

- A. The systems described in this section shall in no way damage or adversely effect architectural or structural systems, components or construction.
- B. Rigging system installation shall be coordinated with the requirement of all adjacent and intersecting systems, including but not limited to: Electrical Systems, Sound, Video and Intercommunications Systems, Stage Lighting, Flooring and Mechanical Systems.
- C. Notwithstanding the detailed information contained in this Specification, it is the responsibility of this Contractor to supply working overall systems. This Contractor shall be responsible, prior to bidding, for verifying the completeness of the parts list, the correctness of the type numbers and the overall suitability of the systems to meet the purposes of the Contract Documents.

- D. Provide all additional components or auxiliary steel needed in order to meet the requirement stated above. Even if not specifically mentioned herein or on the Drawings, this contractor without claim for additional payment shall supply additional components and auxiliary steel.
- E. The Contractor shall in no way be relieved of the primary responsibility to provide a safe, fully functional system.

1.7 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings and samples for approval prior to fabrication. Site dimensions and conditions affecting the Work shall be verified prior to commencement of Shop Drawings.
2. Shop drawings shall be made in conformity with the best modern practice and all design shall reflect a requirement for minimizing institutional maintenance.
3. Submit electronic shop drawings to the Architect for approval. All drawings shall be produced on AutoCAD or compatible system to ensure legibility and quality of submission. Obtain approval of the drawings prior to proceeding with manufacture and fabrication. Shop and field connections of auxiliary steel items shall be clearly distinguished and complete information on connections to other work shall be given. Complete shop drawings shall include:
 - a. Mechanical assembly drawings (1/2" = 1' minimum)
 - b. Mechanical detail drawings. (1" = 1' minimum)
 - c. Component equipment drawings. (1" = 1' minimum)
 - d. General arrangement plans and diagrams. (1/4" = 1' minimum)
 - e. Miscellaneous Details and Assembly Drawings. (as necessary)
 - f. Component equipment drawings shall be Manufacturer's approval drawings or catalogs cuts showing weight, dimensions and capacities of mechanical components.
 - g. Erection plans and diagrams shall give relative locations of various members and overall dimensions with reference to the preliminary drawings including auxiliary structure.
 - h. Miscellaneous details and assembly drawings shall give lengths, widths and sizes of all members, connection details, location, type and size of bolts, rivets, welds, and other connections together with materials to be used.
4. Examination of on Shop Drawings by the Architect shall not be construed as a guarantee of correctness of conditions, but shall only reflect a review of their general conformance with the intent of the Contract Documents.

B. As-Built and Manuals:

1. Within thirty days of the Acceptance Tests, this Contractor shall furnish the following:
 - a. Four copies of a layout of the systems giving the essentials of the installation and their maximum load limitations.
 - b. Four copies of a complete instruction, operations and maintenance book, including all layouts, sizes and technical descriptions of components. These books shall be durable plastic, 3-ring binder. Drawings excepted, all sheet sizes shall be 8-1/2" x 11".
 - c. Four copies of as-built and installed shop drawings. AutoCAD copies of general arrangement, elevations and connection details shall be provided on disk to Owner as part of the As-built drawing submission.

1.8 SUBSTITUTIONS

- A. Requests for equipment substitutions shall be made in accordance with Section 012500.

1.9 TRAINING AND SERVICE

- A. This Contractor shall provide (2) four-hour training sessions for the Owner and Owners representatives. Training session shall cover operational procedures, safety systems, control systems, maintenance of system and troubleshooting. The training session shall be held within (14) days after substantial completion of system installation at a mutually agreeable time to Owner and Contractor. The 2nd training session shall be at a time mutually agreeable with the Owner and Contractor.

PART 2 – PRODUCTS

2.1 MANUFACTURERS AND CONTRACTORS

- A. Rigging systems shall be comprised of components that are the products of one of the following Stage Rigging manufacturers:
 - 1. Texas Scenic, San Antonio, TX (210) 684-0091
 - 2. Wenger/JR Clancy, Owatonna, MN (507) 455-4100
 - 3. H&H Specialties, South El Monte, CA
 - 4. Thern Stage, Winona, MN (800) 553-2204
 - 5. Tiffin Scenic Studios, Tiffin, OH (419) 447-1546
 - 6. I. Weiss, Fairview, NJ (201) 402-6500
- B. Rigging systems shall be installed by one of the following Stage Rigging Contractors:
 - 1. Texas Scenic, San Antonio, TX (210) 684-0091
 - 2. Beck Studios, Milford, OH (513) 831-6650
 - 3. Wenger/JR Clancy, Owatonna, MN (507) 455-4100
 - 4. Staging Concepts, Minneapolis, MN (800) 337-5339
 - 5. Protech, 3431 N. Bruce St. North Las Vegas, NV (702) 639-0290

2.1 MATERIALS and COMPONENTS

- A. General: Items, materials and equipment shall be new and undamaged. Assemblies, cable components, connections, equipment, hardware and linkages employed in supporting, in whole or in part, overhead loads shall be rated and designed for that application.
- B. Rolled Steel Plates, Shapes and Bars: Domestic Steel ASTM A-36-74 unless otherwise noted.
- C. Shackles: Shackles shall be appropriately sized for the intended application. Shackles shall be forged steel with alloy steel pins. Shackles shall be heat treated and tempered. Pins shall be provided with a locking cotter pin to prevent the bolt from loosening. The bolt pin shall be sized to ensure the bearing surface of the bolt is on its shaft. Shackles shall meet or exceed the latest requirement of Federal Specification RR-C-271b.
- D. Turnbuckles: Turnbuckles shall be sized appropriately for the cable construction and diameter of the cable with which they are employed. Turnbuckles shall be Jaw-Jaw type unless otherwise noted in the Contract Documents. Jaw ends shall be furnished with round pins and cotter keys. Turnbuckles shall be dropped forged carbon steel with a galvanized finish. Turnbuckles shall meet or exceed the latest requirement of Federal specification FF-T-791b Type 1, Form 1, Class 8.
- E. Chain: 1/4" Grade 30 Proof Coil Chain, working load limit 1,250 lbs.

- F. Wire Rope: Cables shall be oil free and preformed 7x19 steel core galvanized aircraft cables. Cable size shall be 1/4" diameter unless indicated elsewhere. Breaking strength shall conform to the latest revision of Federal Specification MIL-W-83420.
- G. Thimbles, Wire Rope: Wire rope thimbles shall be sized appropriately for the cable construction and diameter of the cable with which they are employed. Thimbles shall be hot dipped galvanized carbon steel. Thimbles shall meet or exceed the latest requirements of Federal Specification FF-T-276b, Type III.
- H. Formed Steel Batten Clamps: 12 gauge 1 1/2" formed steel plate with (2) bolt holes for 3/8" hex bolts and (1) top mount hole for 1/2" connection hardware.
- I. Compression Sleeves: Compression sleeves shall be sized appropriately for the cable construction and diameter of the cable with which they are employed. Sleeves shall be oval for cable connections and cylindrical for stop sleeves. Sleeves shall be copper. After application sleeves shall meet or exceed the latest requirements of Military Specification MIL-W-83420.

2.2 BROADCAST STUDIO GRID

- A. Pipe Grid: Pipes shall be 1-1/2" Schedule 40 carbon steel pipe (maximum 1.92" OD). Pipe batten splice joints shall be 18" long, with sleeve equally spaced each side of joint. Splice sleeve shall be secured to pipe batten four 5/16" grade 5 hex bolts and low-profile nylon insert lock nuts. Bolts shall be set 90 (deg) from each adjacent bolt. Length of grid pipes shall be as shown on the drawings. Each pipe shall incorporate full pipe sections (21'-0" long) with only the minimum number of partial sections required by the necessary length. Grid pipes shall be painted flat black.
- B. Pipe Grid Cross Splice Plates: Splice plates shall rigidly secure the grid pipes at intersecting points. Splices shall be fabricated from minimum 1/4" steel plate with four (4) 5/16" plated U-bolts securing the pipe to the splice plates. Each U bolt shall utilize a nylon insert locknut. Cross splice plates shall be located at every crossing point of two pipes. Splice plates shall be painted flat black.
- C. Hanging Assembly: Grid hanging assembly shall utilize formed steel batten clamps, grade 30 proof coil chain and custom hanging mounting bracket as required by field conditions. Verify steel locations and connection assembly prior to fabrication. Hang the grid from the structural steel and anchor the grid to the underside of the deck where indicated on the drawings and as instructed by the project structural engineer. Rigging Contractor note, the hanging assemblies will have to pass through the ceiling to attach to the building structure. Coordinate pipe grid work with the ceiling contractor. Rigging contractor to provide 4"d escutcheon plates at all ceiling penetrations. Approval of escutcheon plates will be made by the Architect prior to installation.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine all work prepared by others to receive work of this Section and report defects affecting installation to the Owner's Representative for correction. Commencement of the work shall be construed as complete acceptance of preparatory work by others. The sphere of inspection shall include but not be limited to:
 - 1. Assurance all mounting surfaces are ready to accept the Work.
 - 2. Verification of flatness, plumb and level of mounting conditions.
 - 3. Inspection of all components of the Work to insure no damage has occurred during shipping or storage.

3.2 PREPARATION

- A. The Contractor shall verify field measurement at the site prior to installation and modify the system accordingly.

- B. The Contractor shall coordinate the Work with related trades and the Owner's Representative. This shall include the preparation of schedules and coordination of equipment delivery and storage.
- C. Storage at the site shall be coordinated with the Owner's Representative and shall insure the materials and components are undamaged. Any material stored at the site shall be protected from damage by the work.
- D. Appropriate signage shall be furnished during overhead work to caution of personnel working above.

3.3 INSTALLATION AND ERECTION

- A. The installation workmanship shall provide straight, plumb, true and aligned components throughout. All connections shall be tight fitting with a minimum safety factor of eight and all arranged in an orderly manner. The mechanical installation shall possess the necessary properties to withstand stresses of tension, compression, flexure, shear, and torsion which may be anticipated being imposed on one or more of the components; and shall be related to 1) safety, 2) ease of operation, 3) quietness of operation, and 4) service life. The standards of quality and design covering the equipment and fabrication plus the installation technique required are established on this basis. The decision of the Architect in determining the acceptability of equipment items, installation technique and workmanship shall be final.
- B. This Contractor shall conform to the best trade practices, fabricating and installing all items in accordance with manufacturer's recommendation and Architect direction, and shall coordinated with trades doing adjoining work.
- C. During the course of his work, this Contractor shall daily remove to collection points at the job site, all loose trash and scrap materials. At the completion of his work, he shall leave all related work areas broom clean.
- D. Installation shall be complete with all members and materials, and all bolts, nuts, washers, clips, fittings, supports, or other items required for attaching all equipment specified to the existing construction.
- E. This contractor shall do all required cutting, drilling, tapping and fitting to properly install and secure his work in place. Cutting or drilling existing structural or finishing work shall have the prior approval of the Architect.
- F. The mechanical fabrication and workmanship shall incorporate neat and mechanically acceptable practices such as clean drilled and punched holes without flash, hard smooth finish for all sheared machines, and cut edges, and proper fit of components and contiguous parts without irregularity where marching is intended. Welding shall meet qualifications of A.I.S.C. manual and shall be without spatter and other evidence of poor practice. All moving parts shall have specified tolerance, shaft sizes, bearings, mounting, connections, and accessories coordinated into the work in a manner acceptable to the Architect. No wood construction or equipment shall be incorporated into the work excepting as may be set forth in the Specifications.
- G. The fabrication of all equipment shall incorporate only new and unused materials. This includes all metal components in various shapes required such as plate, bar, rod, castings, structural, stampings, forgings, clamps, bolts, bearings, chain, pipe, sleeves, slips, cable and all other accessories not mentioned.
- H. The installation costs included in this proposal shall be based upon the use of experienced riggers.
- I. It shall be part of this scope of work to install, adjust and demonstrate operation of all stage curtains. Adjustment shall include leveling, cleaning and repair if necessary.

3.4 SYSTEM CONSTRUCTION/RIGGING

- A. General:

1. Maintain low trim indicated by the contract documents.
2. Pipe battens shall be aligned along both ends when in the low trim position. Liftline shall align upstage/downstage.
3. Anchoring to the building shall be made by use of epoxy anchors, thru bolting, machine bolts and shields or other approved anchor in lieu of lag bolts or toggle bolts. Connection to gypsum wallboard ONLY is not permitted. Where structural connections are made directly to hollow concrete block, provide thru-bolt connection with backing plate as required.

B. Block Connection:

1. Blocks shall be aligned as required by the drawings. Alignment shall meet the requirements set herein.
2. Blocks shall be secured per approved mounting design. Where connection device contact is not uniform, steel shims shall be used. Mountings shall be performed to insure blocks are securely attached to the mounting structure and are immobile except by intentional user action.

C. Cable Connection and Reeving:

1. Typical linesets shall be reeved with 1/4" 7x19 GAC for the lift lines.
2. Each lift line shall be one continuous length of cable. Mid-line splices shall not be accepted. Cable shall be cut and sleeves compressed only by use of the appropriate tool and operation for the cable and application.
3. A trim chain of 1/4" Grade 30 Proof Coil chain, 36" long, shall be secured to the batten end of the load with a 1/4" drop forged loose pin anchor shackle. The chain shall be wrapped around the batten one and a half times and be secured to the thimble with a second shackle.
4. It shall be the responsibility of this Contractor to receive and install the onstage lighting raceways along with the electrics rigging batten. The Electric lineset lift lines shall each have 3/8" x 6" jaw/jaw turnbuckles and formed batten clamps. The clevis shall be trimmed in a manner similar to the shackle described herein. After trimming for level along the batten length turnbuckles shall be moused with malleable wire to prevent rotation.

3.5 SIGNAGE AND PAINTING

A. Provide the following signage and painting details:

1. At the stage left wall (adjacent to the locking rail) and at the loading gallery, provide a clear plastic encapsulated framed sign 24"x 36" indicating:
 - a. Lineset loading capacities and dead-hung pipe loading capacity.
 - b. Operational procedures and safety warnings.
 - c. Lineset layout with numerical identification and spacing from plaster line.
2. Provide two 6"x8" signs at the loading gallery (upstage and downstage of gallery) which identifies the weight of each counterweight brick (1" & 2" thick @ 6" wide). Mount signs as required to the walls.
3. Provide "Insert Spreader Here" signs on each arbor at 24" increments.
4. Paint the House Weight counterweights with yellow paint.

3.6 INSPECTION AND TESTING

- A. The Architect or his appointed representative, following receipt in writing or notification from this Contractor that the installation is completed shall make final inspection. If inspection reveals any detail of construction, fabrication, or installation not in strict accord with the specification and contract requirements, approval shall be withheld and Contractor shall be given thirty days to replace the rejected items with those conforming to specification requirements. In addition to the

final inspection of various equipment components the Architect shall have the right of inspection during the course of the installation, and he shall be allowed access to materials at the side for eventual incorporation in the work. Preliminary inspection shall not be constructed as eliminating the possible rejection of various components during the final inspection detailed above.

- B. The completed installation of the stage rigging system shall be tested and operated for the approval of the Architect or his representative by the Rigging Contractor prior to approval.
- C. Final tests and inspections are approved when:
 - 1. Punchlist items complete.
 - 2. Submittal of three copies of warranty.
 - 3. Submittal of record drawings and flame test certificates.

END OF SECTION 11 06 00

SECTION 22 11 23.29 - HORIZONTAL SPLIT CASE BOOSTER PUMPS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

This specification shall govern the furnishing of all materials, labor and equipment for three (5) potable water booster pumps and electric motors at the locations as shown on the plans.

1.2 QUALITY ASSURANCE

Provide highest quality workmanship and materials throughout. Furnish equipment manufactured by a manufacturer with at least five years of experience in the design and building of water equipment.

1.3. SUBMITTAL DATA

- a. Pump manufacturer shall provide six (6) sets of the following for review and approval prior to beginning manufacture.
 - 1) Pump performance curve
 - 2) Composite dimensional outline Drawing of pump, motor, and baseplate.
 - 3) Pump data sheet describing:
materials of construction, coupling, mechanical seal, baseplate, motor, and rated design conditions of pump and motor.
 - 4) The following manufacturer's factory certification of compliance signed by an officer of the company.

PART 2 - PRODUCTS

2.1 PUMPS

- a. Description: Furnish three (3) single-stage, end suction, centrifugal pumps designed for potable water pumping applications. Furnish pumps conforming to this specification and schedule as manufactured by Pentair or approved equivalent. Design unit is Pentair Model 411, 1775 RPM, 40 H.P., 230/460 volt, 3 rated for a discharge characteristic as shown on plans.
- b. Casing: The pump casing shall be of close grained cast iron ASTM-A-48. The suction and discharge connections shall have standard pipe threads. Casing shall be rated for 250 lbs. working pressure. The casing shall be supported on pedestals cast integrally with the casing and be of the back pull out design. The casing shall have a permanently fixed stainless steel nameplate.
- c. Impeller: The impeller shall be enclosed design, cast in one piece and dynamically balanced. Impellers shall be cast bronze and be statically and dynamically balanced.
- d. Wearing Rings: The pumps shall be equipped with bronze casing rings. The casing rings shall be held laterally by groove locks in the upper and lower casing. Locks in the lower half casing shall be provided to prevent rotation. The impeller shall have integrally cast wear rings and shall be designed so that impeller rings can be mounted in the future by machining the impeller wear surface.
- e. Shaft: Impeller shafts to be constructed of high strength steel conforming to AISI Specifications C-1045.

- f. Bearing Frame: Bearing frame shall be heavy duty cast iron with integrated cast feet.
- g. Bearings: The pumps shall be equipped with ball-type bearings. Thrust bearings shall be double row type securely held in position on the shaft by a machined shoulder and snap ring. Radial bearings shall be free to float axially in the bearing housing. Thrust bearings shall be locked in place. Bearings shall be designed for a life of 50,000 hours. Bearings shall be permanently lubricated and sealed.
- h. Mechanical Seals: Pumps shall be equipped with mechanical seals. Seals shall be either Tungsten/Carbide or Silicon Carbide.
- i. Coupling: Pump couplings shall be Dodge Paraflex, Orange Crush or Woods S/B coupling with rubber flexing members. Provide factory manufactured coupling guards.
- j. Alignment: Installing contractor shall perform final field alignment of coupling in accordance with manufacturer instructions and specifications.
- k. Baseplates: Pumps and motors shall be mounted on cast iron or fabricated steel drip base with connection for drain. Base shall have grout holes and shall be grouted in after final alignment.

2.2 MOTORS

- a. Motors: Electric motors shall be NEMA Design B squirrel cage induction type, open drip proof with 1.15 service factor and suitable for operation on 230/460 volt, 3 phase, 60 hertz power supply. Alternately, provide a severe duty TEFC Motor with the same service factor rating. In either case the motor shall be rated "High Efficiency".
- b. Each motor shall be designed for continuous operation without exceeding the name plate amperage rating at a 1.15 service factor for any condition of head versus capacity for the full range of the pump curve as provided by the pump manufacturer.
- c. Motors shall conform to the latest revision of NEMA Standard MGI as manufactured by General Electric, Westinghouse, U.S. or preapproved equivalent.

PART 3 - EXECUTION

3.1 SERVICE

- a. A factory representative, as an advisor, shall be provided during the initial installation work; for the inspection and checkout of erected equipment; and during instruction for initial operation. These services are to be for two (2) periods not exceeding five (5) days each.
- b. Furnish the Owner with a written report from a service engineer employed by the manufacturer denoting start-points and calibrations. Obtain Engineer's approval of final settings.
- c. Arrange for manufacturer to have service personnel on 24-hour call.

3.2 WARRANTY

The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of one (1) year from the date of final acceptance, under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.

END OF SECTION 11 23 29

SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Kitchen appliances.
 - 2. Laundry appliances.
- B. Related Sections:
 - 1. Division 22 - Plumbing: Plumbing connections for appliances.
 - 2. Division 23 - Mechanical: Exhaust connections for appliances.
 - 3. Division 26 - Electrical: Electrical connections for appliances.

1.2 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).
- C. Gas Appliances: Bearing design certification seal of American Gas Association (AGA).

1.5 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.
- D. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Frigidaire Home Products: www.frigidaire.com.
 - 2. GE Appliances: www.geappliances.com.
 - 3. Whirlpool Corp: www.whirlpool.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 KITCHEN APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Free-Standing Refrigerator, RF1: OFOI.

- C. Under-Counter Refrigerator, RF2:
 - 1. Basis of Design: Model GME04GLKLB as manufactured by General Electric.
 - 2. Capacity: Total minimum storage of 4.40 cu ft, minimum of 0.47 cu ft freezer capacity.
 - 3. Features: In-Door Can Rack, Glass Shelves, Mini Freezer Ice Tray, Wire Door Shelves.
 - 4. Refrigerant Type: R-600A - HFC- Free Refrigerant.
 - 5. Exterior Finish: Stainless Steel.
- D. Microwave: Built-In.
 - 1. Basis of Design: PEM31SFSS manufactured by GE Appliances.
 - 2. Capacity: 1.1 Cu ft.
 - 3. Power: 1200 watts.
 - 4. Features: Include turntable and built-in trim kit.
 - 5. Exterior Finish: Stainless.

2.3 LAUNDRY APPLIANCES

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Clothes Washer, CW1: Top-loading stationary.
 - 1. Basis of Design: LWNE22SP115TW01 manufactured by Speed Queen.
 - 2. Size: Large capacity.
 - 3. Controls: Solid state electronic.
 - 4. Cycles: Include normal, permanent press, delicate, soak, and automatic soak.
 - 5. Motor Speed: Single-speed.
 - 6. Features: Include optional second rinse, bleach dispenser, fabric softener dispenser, sound insulation, and end of cycle signal.
 - 7. Finish: Painted steel, color white.
- C. Clothes Dryer, CD1: Electric, stationary.
 - 1. Basis of Design: LDEE7RGS173TW01 manufactured by Speed Queen.
 - 2. Size: Large capacity.
 - 3. Controls: Solid state electronic, with electronic moisture-sensing dry control.
 - 4. Temperature Selections: Four.
 - 5. Cycles: Include normal, permanent press, knit/delicate, and air only.
 - 6. Features: Include interior light, reversible door, stationary rack, sound insulation, and end of cycle signal.
 - 7. Finish: Painted steel, color white.
- D. Stackable Washer and Dryer, WD1: Electric.
 - 1. Basis of Design: GUD27ESSMWW manufactured by General Electric.
 - 2. Size: Full Size.
 - 3. Controls: Rotary Electromechanical.
 - 4. Temperature Selections: Four.
 - 5. Cycles: 11 washer/ 4 dryer.
 - 6. Features: Dewrinkle, Quick Fluff, Up-front lint filter.
 - 7. Finish: Painted steel, color white.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify utility rough-ins are provided and correctly located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

3.3 ADJUSTING

- A. Adjust equipment to provide efficient operation.

3.4 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION 11 30 13

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SECTION 11 40 00

FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Documents, apply to the Work specified in this Section.

1.2 SUMMARY OF THE WORK

- A. Project Name and Location: Huffman ISD New CTE
25400 Willy Lane
Huffman, TX 77336
- B. Approval of Working Surface: Any contractor performing work over the work of other contractors shall notify the Architect of any unsatisfactory conditions. The beginning of work by any contractor shall constitute acceptance of the previous work.
- C. Field Verification of All Dimensions: Before ordering any materials or doing any work, field verify all measurements of the building and be responsible for their accuracy. No extras will be allowed for variations from drawings in existing conditions or work performed under this contract. Any discrepancies found shall be submitted to the Architect or Foodservice Design Professionals (FDP) for instructions before proceeding.
- D. Cutting and Patching: No excessive cutting will be permitted, nor shall any structural members be cut without the written approval of the Architect. Each Contractor shall leave all chases and openings straight, true, and of the proper size in their work, as may be necessary for the proper installation of their and other contractors' work. After such work has been installed, the contractor shall carefully fit around, close, repair, patch, and point up the same as directed to the satisfaction of the Architect.
- E. Cooperation: The General Contractor, all other contractors, and all subcontractors shall coordinate their work with all adjacent work and shall cooperate with all other trades to facilitate the general progress of the work. Each trade shall afford all the other trades every reasonable opportunity to install their work and store their material.
- F. Inspection and Tests: The architect, Owner, Foodservice Design Professionals (FDP), and their representative shall always have access to the work, whether in preparation or progress. Provide proper and safe facilities for such access and inspection.
- G. Fees, Permits, and Inspections: Secure and pay fees for all permits, licenses, and inspections as required by all authorities having jurisdiction. Give all notices and comply with all laws, ordinances, codes, rules, regulations, and contract requirements bearing on the work.

1.3 SCOPE OF WORK

- A. Include the Work specified, shown, or inferable as part of Food Service Equipment. Portions of this Work may be subcontracted to those qualified to do such work as necessary because of jurisdictional trade agreements and restrictions.
- B. The General Contractor is responsible for Related Work specified in other Sections: i.e., final plumbing, electrical and mechanical connections. The Kitchen Equipment Contractor (KEC) is responsible for all internal connections.

- C. Specifications and drawings have been prepared to form the basis for procurement, erection, start-up, and equipment adjustment in this contract. Plans and specifications shall be considered mutually explanatory. Work required by one, but not by the other, shall be performed as though required by both. Items required by one but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings so that all equipment items shall be entirely functional for the purpose for which they were designed and intended. Provide all necessary material, tools, equipment, and labor required for the complete delivery, un-crating, erection, and installation as designated on the food service equipment plan and, in the specifications, to be made ready for final connection by the appropriate Division contractors. When there is any discrepancy between drawings and specifications, bidders should seek clarification of any discrepancies from the Architect and or Foodservice Design Professionals (FDP) before bidding.
- D. Should the drawings disagree in themselves or the specifications with the drawings (*and clarification was not sought before bidding*), the higher cost, better quality, more stringent, and greater quantity of the work or materials shall be completed without additional costs to the Owner.

1.4 OTHER DIVISIONS/CONTRACTORS RELATED WORK

A. Division 03 (Concrete) is responsible for but not limited to:

- 1. Slab depressions reinforced concrete wearing bed at prefabricated walk-in assemblies.
- 2. Concrete or masonry platforms (with a finished top and coved base at the perimeter) for the raised setting of food service equipment.
- 3. Slab depressions to receive stainless steel drain trench liner/grate assemblies (provided under this Section).

B. Division 09 (Finishes) responsible for but not limited to:

- 1. Interior finished floor with a coved base at prefabricated walk-in assemblies.

C. Division 10 (Specialties) responsible for but not limited to:

- 1. S/S Corner Guards throughout the kitchen (unless specified otherwise).
- 2. Lockers.

D. Division 22 (Plumbing) is responsible for but not limited to:

- 1. All connections shall be made in accordance with local codes and national standards, except where plans and specifications exceed those codes and standards.
- 2. Empty PVC and wide-sweep bends for refrigerant piping to beverage lines, Co2 lines, and remote food service equipment refrigeration systems.
- 3. Rough-in and final connection of plumbing systems to food service equipment and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 22. This includes but is not limited to the installation of all faucets (water fill faucets, pre-rinse faucets, etc.), hoses, gas disconnects and drains from the equipment point of connection to building plumbing systems. All drain lines are provided and installed by Div. 22.
 - a. Kitchen Equipment Contractor is responsible for providing all faucets (water fill faucets, pre-rinse faucets, etc.), drain fittings, mixing valves, control valves, water

pressure regulators, vacuum breakers, and all accessories for equipment specified under 11 40 00. Division 22 is responsible for installation.

4. Indirect drain line runs from the equipment to the nearest drain or floor sink—lines to be type 'K' Copper.
5. If any plumbing accessories or fittings are provided loose with equipment by 11 40 00, Div. 22 is to attach to equipment and provide final connection.
6. Gas Supply Systems with all components and fittings required for a complete system.
7. Water Supply Systems with all components and fittings required for a complete system.
8. Compressed Air Systems with all components and fittings required for a complete system (if required for this project).
9. Piping and Drainage Systems (Sanitary and Grease-laden). ***Systems must be cleaned and flushed before the final connection with food service equipment - Critical.***
10. Floor Sinks (Provide and Install). Flange and grates to be flush with the finished floor.
11. Floor Drains (Provide and Install). Flange and grates to be flush with the finished floor.
12. Trench Drains (Provide and Install). Trench Liners provided by 11 40 00. Flange and liners to be flush with the finished floor.
13. Grease Traps as required (Size, Provide, Locate, and Install). Verify with local codes to bypass or pipe through Grease Trap and/or Interceptor.
14. P-Traps as required (including all disposers).
15. Interconnect water through Water Filter (Filter provided by 11 40 00 unless otherwise specified) to equipment.
16. Gas Quick Disconnect Installation (Quick Disconnect provided by 11 40 00).
17. Safety Restraint Cable Installation (Safety Restraint Cable Provided by 11 40 00).
18. Specified couplings and piping to all equipment furnished by 11 40 00.
19. Air Compressors (if required for this project) (Size, Provide, and Install unless otherwise specified).
20. Water Softeners (if required for this project) (Size, Provide, and Install unless otherwise specified).
21. Pressure Boilers (if required for this project) (Size, Provide, and Install unless otherwise specified).
22. Hand Sinks (Provide (unless otherwise specified) and Install). Provide a hot water tempering valve if required. Water temperature to be at least 100 degrees and flow for at least 20 seconds.
23. Ice Bin Drain Insulation (if Ice Machine is provided in this project) (Provide and Install).
24. Unions at disposer solenoid valves (if Disposer is provided in this project) (Provide and Install).

25. Back Flow Prevention as required (Provide and Install - including all disposers). Back-Siphonage shall be installed at all fixtures and equipment where backflow and/or back-siphonage may occur and where a minimum air gap cannot be provided between the water to the fixture or equipment at its flood/level rim. When furnished with equipment, vacuum breakers shall override the above if acceptable with applicable codes. Division 22 is responsible for verifying requirements with local codes.
26. Janitor Sink with Faucet (Provide and Install).
27. Freeze Proof Hydrant at the exterior of the building by receiving door (Provide and Install - unless otherwise specified).
28. Reverse Osmosis Systems (Size, Provide (unless otherwise specified), Locate, and Install).
29. All piping within the counter body or under fabricated counters must be run to a connection point below the counter body by Section 11 40 00—final connection by Division 22.
30. Exhaust Hood condensate drain connections (if Exhaust Hood is provided in this project) (Provide and Install).
31. Interconnection of ½" CW to Pre-Rinse and Disposers cone/body inlets piped through the solenoid and vacuum breaker (if Disposer is provided in this project).
32. Fire System Piping. The exposed piping is to be chrome plated.
33. Pipe ½" cold water to swirl inlets at disposers (if Disposer is provided in this project).
34. Water Treatment for Ice Builders (Non-Chlorinated water with a PH Level of 10 or Higher) and any drains and overflows. Piping from Ice Builders to Tumble Chillers by Div. 23 (if Ice Builders and Tumble Chillers are provided in this project).
35. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

E. Division 23 (Mechanical) responsible for but not limited to:

1. All connections shall be made following local codes and national standards, except where plans and specifications exceed those codes and standards.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Rough-in and final connection of mechanical systems to food service equipment, walk-in assemblies, and between components (including materials and labor).
4. A mechanical contractor will test and balance rooms and exhaust hoods. **Balance report for food service Exhaust Hoods to be provided to Foodservice Design Professionals (FDP) immediately upon completion (send to Houston.Submittal@fdp.org) and must be submitted with O&M manuals.**
5. Exhaust Hoods, Condensate Hoods, Fire Suppression Systems, connections, and controls (Provide and Install – unless otherwise specified). Provide tempered air at all supply ducts.

- a. If Exhaust/Condensate Hoods and Fire Suppression Systems are specified under Section 11 40 00, Division 23 is responsible for all Exhaust and Condensate Hood connections (Provide and Install).
6. VFD System and controllers when required by code (Provide and Install).
7. Provide and install all ventilation (direct or indirect), air conditioning, and heating systems (unless otherwise specified).
8. Coordinate Supply and Return ducts above Serving Counters. No cold air is to blow directly on hot food counters or open-air refrigerated merchandisers.
9. Coordinate Supply and Return ducts away from equipment with top-mounted refrigeration. No cold air is to blow directly on compressors.
10. Mechanical Contractor to locate temperature monitors within return ducts.
11. Circulating air above walk-in assemblies (Provide and Install).
12. Circulating air above and in air gaps at warehouse cold storage assemblies (Provide and Install).
13. Water Chillers as required (if equipment is provided in this project) (Provide, Size, and Locate).
14. Piping from Ice Builders to Tumble Chillers (if equipment is provided in this project) (Size, Provide and Install).
15. Refer to Section 2.2 PLUMBING / MECHANICAL REQUIREMENTS for additional information.

F. Division 26 (Electrical) responsible for but not limited to:

1. Rough-in and final connection of electrical systems to food service equipment, walk-in assemblies, and between components (including materials and labor). Accessories provided loose with food service equipment by Section 11 40 00 to be field installed by Division 26.
2. Empty EMT Conduit with pull-wire and wide-sweep bends for refrigerant piping to remote food service equipment refrigeration systems.
3. Empty EMT Conduit with pull-wire and wide-sweep bends for interconnect cables between LAN and POS terminals, change-makers, pre-check units, printers, CPUs, etc. Division 26 to verify where the conduit will run for POS System (i.e., Manager's Office or IDF Room).
4. Empty EMT Conduit with pull-wire and wide-sweep bends for fire suppression systems. Interconnect the Fire Protection System to panel box shunt trips and building alarms.
5. Walk-in Assembly Light Fixture Installation (Provided loose by Section 11 40 00) (if Walk-in is provided in this project).
6. Table Limit Switch Installation (Provided loose by Section 11 40 00) (if Dishmachine is provided in this project).
7. Electrical Materials and Devices (Shunt-trip breakers, surge protectors, lighting control devices, conduit, wire, etc.).

8. Switches and Stainless Steel Disconnects as required (Provide, Locate, and Install – to be in an accessible location).
9. Charging Stations for Forklifts, Pallet Stackers, and Pallet Jacks (Size, Provide, Locate, and Install) (if equipment is provided in this project).
10. Interconnection between Condensate Fan and Dishmachine control panel (if equipment is provided in this project).
11. Interconnection between Exhaust Hood fans and switch (if equipment is provided in this project).
12. Interconnection between Exhaust Hood lights and switch (if equipment is provided in this project).
13. Door Heaters, Lights, Coils, and Heated Pressure Relief Ports pre-wired to the junction box at the top of walk-in assemblies (if equipment is provided in this project) provided by Section 11 40 00—final connection by Div. 26.
14. If any electrical accessories, fittings, and cord/plugs are provided loose with equipment by 11 40 00, Div. 26 is to attach to equipment and provide final connection.
15. Provide waterproof receptacles in wet areas.
16. All electrical connections beneath Exhaust Hoods (if equipment is provided in this project) to extend to shunt trip breakers with electrical panel box for shutdown during fire mode.
17. Receptacles will be pre-wired to Junction Box or Load Center for final connection by Division 26.
18. All electrical lighting, power, and distribution systems.
19. Do not interconnect more than three (3) convenience outlets on one (1) breaker.
20. Other than convenience outlets, all electrical connections on food service plans are dedicated breakers.
21. Doorbell at receiving door (Provide and Install –audible throughout Kitchen, Office, and Dry Storage room).
22. Adequate lighting at receiving door.
23. Dedicated circuit for heated drain line connection in Walk-In Freezer (120/1/16.0 Amp) at each coil.
24. (if Walk-in is provided in this project) Walk-in Manufacturer is to provide Two (2) Edwards 860 Series (or equal) red lens, surface-mounted Xenon Emergency Strobe Beacons. Walk-in manufacturer will install One (1) located in the Kitchen above Walk-In Freezer door (or Cooler door when Freezer is within Cooler in an 'inline' assembly), and provide the second unit loose for installation by Division 26 located in the Cafetorium (Division 26 to coordinate location with Owners and Architect). Division 26 is to provide all conduit and wiring required and interconnect the illuminated Push Button Panic Alarm in the Walk-In Freezer to both Strobe Beacons (**Critical**). Coordinate with Division 27.
25. Electrical contractor to provide conduit with pulled wires prior to installation of equipment.

26. Refer to Section 2.5, ELECTRICAL REQUIREMENTS, for additional information.

G. Division 27 (Communication) responsible for but not limited to:

1. Data line coordination for food service equipment.
2. Time clocks as required.
3. Video cameras for learning assistance in food service areas as required (Provide, Locate, and Install).
4. (if Walk-in is provided in this project) (Provide conduit, data line, and interconnect the illuminated Push Button Panic Alarm inside the Walk-In Freezer to the Building Automation System (BAS). When activated, facility personnel are to be notified - coordinate notification requirements with the Owner (**Critical**). Coordinate with Division 26.

H. Division 28 (Electronic Safety and Security) is responsible for but not limited to:

1. Security Cameras as required (Provide, Locate, and Install).

I. General Contractor responsible for but not limited to:

1. Any wall penetration required for food service equipment utilities. Escutcheon plates or S/S sleeves are to be provided and installed as needed.
2. Bulk Freezer Ventilation Pipe (if Bulk Freezer is provided in this project) (Provide and Install unless otherwise specified).
3. Core drilling for Guide Rails (if Guide Rails are provided in this project).
4. Refrigeration Roof Curbs / Roof Jack (if Refrigeration System is provided in this project and located on the roof).
5. Interior Bollards (if required for this project) – to be epoxy painted per local codes (Provide and Install).
6. Furnish and Install $\frac{3}{4}$ " Plywood blocking in the wall for mounting equipment furnished by Section 11 40 00 as required.
7. Walk-in Depressions (to be dead level) and sand leveling bed (if Walk-in is provided in this project and recess is shown).
8. Structural bracing for Bulk Walk-in Assembly ceiling panels if required.
9. Menu System Video Monitors in Servery (unless otherwise specified).
10. Structural bracing for Menu System Video Monitors if required.
11. Interior/Exterior refrigeration penetrations and sleeves at building penetrations.
12. DoorScope viewer (peephole) with wide viewing angle at receiving door.
13. Canopy at receiving door. Coordinate height with the height of Receiving Door (8') and the mounting height of Air Screen above the door.
14. Soap and towel dispenser provided by Owner. G.C. is responsible for installation.
15. Washer and Dryer (Provide and Install, unless otherwise specified).

16. Dwarf wall at exposed front/ends of cafeteria serving counters with the finish as selected by the Architect (if required in this project).
17. Substrate (Provide and Install) at SS Wall Caps for pony walls.
18. Final cleaning of all equipment before demonstrations.

1.5 QUALITY ASSURANCE

- A. In addition to complying with all applicable laws, statutes, building codes, and regulations of public authorities, comply with the following:
 1. National Sanitation Foundation (all equipment to bear label)
 2. National Electric Code
 3. Underwriters' Laboratories, Inc. (all applicable equipment to bear label)
 4. American Gas Association Laboratories
 5. National Fire Protection Association
 6. Americans with Disabilities Act
 7. Food and Drug Administration HACCP Guidelines
 8. International Energy Conservation Code (IECC)
 9. Department of Energy
 10. Environmental Protection Agency
 11. CSA Group
- B. Furnish certification of regularly manufactured equipment listing or classification by Underwriter's Laboratories, Inc. with the initial submittal.
- C. Furnish a list of equipment and components (internal and external) that are not of domestic origin. All equipment and components (internal and external) should be of domestic origin when possible. This information should be provided with the initial submittal.
- D. Projects outside the continental United States shall adhere to all local authorities having jurisdiction over that project.

1.6 SUBSTITUTIONS

- A. **The specified equipment items or components are intended to be the basis of the bid. All other brands, including any additional names, which may be listed as "Alternates" or "Approved Equal," must conform with the general and item specifications, warranties, size/dimensions, quality, accessories, function, voltage, horsepower, etc. of the first-named brand and be subject to Paragraph C-03 of this Article.**
- B. Proposed Substitutions:
 1. Submitted at least 14 calendar days before Bid Date.
 2. Submit proposed substitutions with catalog data and manufacturer's shop details indicating all modifications required to conform with the specified brand.

3. List of deviations must include equipment name, model number, accessories, and features with deviation(s) noted for specified and proposed alternate equipment. Equipment without listed deviation(s) will be considered furnished as specified.
- C. Substitutions with prior approval:
1. Submitted on Bidder's letterhead attached to Proposal Form with individual additive/deductive amounts stipulated and the documentation required in Paragraph B-02.
 2. Owner reserves the right to accept or reject any or all substitution proposals before execution of the Contract.
 3. Provide all design/engineering services required to adjust in space, systems, utilities, etc., and pay all additional costs of utilities, construction, or professional services that may be incurred due to the acceptance of any substitution.
- D. All appliances or other equipment within a common group or category (e.g., refrigerators, kettles, ovens, shelving, etc.) must be from the same manufacturer.

1.7 INTERPRETATION OF DOCUMENTS

- A. During Bidding: Bidder's, supplier's, or vendor's questions and comments about Construction Document's clarity or intent will be addressed by addendum.
- B. After Award:
1. Clarification Bulletin will confirm Construction Document requirements.
 2. Request for Information submitted by Contractor shall contain Contractor's proposed resolution.

1.8 WARRANTY

- A. Provide a written warranty for parts and labor for one year **from the date of Substantial Completion**, including an extended four-year replacement warranty on compressor bodies.
- B. Components of equipment subject to replacement before one year's use (such as refrigerator door gaskets) and those items which may fail due to improper or inadequate periodic maintenance by the Owner/Operator (such as an uncleaned refrigeration system condenser) are not intended to be included within the scope of the Warranty.
- C. Refrigeration Systems/Equipment: One-year free service available within twenty-four hours of notification.
- D. Furnish three copies of a list of all equipment and their respective local service agencies, indicating the address, telephone number, and name of the person to contact. The service agencies selected shall be factory-authorized for the equipment assigned whenever possible.
- E. Provide the following for refrigeration systems/equipment unless specified otherwise:
1. One (1) year of free refrigeration system service is available within twenty-four hours of notification.
 2. Provide five (5) year manufacturer's registered written replacement warranty certificate covering compressor bodies. Warranty to cover labor costs for the first year.

3. Provide ten (10) years of the manufacturer's registered written replacement/repair warranty certificate covering walk-in assembly panels. Warranty to cover defects in material and workmanship. Warranty to cover labor costs for the first year.
 4. Provide two (2) year parts and labor warranty for **all parts/components (including third-party components that may be utilized)** of the refrigeration system(s) **(including freon)**, walk-in cooler(s), and freezer(s) not otherwise covered herein.
- F. **All above-stated warranty periods are from the date of Substantial Completion.** All replacement parts due to a warranty call should be the same quality as the original, or better if the original were defective. Replacement parts should be of a domestic origin where possible.

1.9 SUBMITTAL DATA

- A. **All submittals must be received, reviewed, and approved as noted prior to equipment procurement. If any equipment is procured prior to this process, it is on the KEC to replace any equipment, accessories, or other components that may not meet the specifications or design intent for the facility, including all costs associated with rectifying the errors made procuring the equipment before this critical process.**
- B. Special Requirements: The following are in addition to any general requirements given elsewhere in the Documents.
- C. Submittal Requirements:
1. Kitchen Equipment Contractor to furnish all submittals via PDF, drawings to be scaled per General Specifications and provided in Three (3) submittal packages.
 2. Foodservice Design Professionals requires the below-listed business days for each package submitted. Packages are to be submitted within 14 days between each issued package. Each package should contain individual submittal sets.
 - a. Package One to include (2) Individual sets: 10 Business Days for Review
 - i. Equipment rough-in
 - ii. Equipment Brochure
 - b. Package Two to include (3) Individual sets: 10 Business Days for Review
 - i. Exhaust Hoods
 - ii. Walk-in Cold Storage Assemblies
 - iii. Refrigeration
 - c. Package Three to include (4) Individual sets: 15 Business Days for Review
 - i. Custom Fabrication
 - ii. Serving Counters
 - iii. Merchandising Equipment
 - iv. Miscellaneous Submittals
- D. Submittals to be identified with the below-listed file name structure:

1. 11 40 00-1 EQUIPMENT BROCHURE
 2. 11 40 00-2 EQUIPMENT ROUGH-IN PLANS
 3. 11 40 00-3 CUSTOM FABRICATION
 4. 11 40 00-4 SERVING COUNTER
 5. 11 40 00-5 EXHAUST HOODS
 6. 11 40 00-6 WALK-IN COLD STORAGE ASSEMBLY
 7. 11 40 00-7 REFRIGERATION
 8. 11 40 00-8 BEVERAGE MERCHANDISER
- E. Package One (1) requires both submittals: Brochure and Rough-in plans. **If not sent together, the submittal will be rejected.**
- F. Foodservice Design Professionals (FDP) will notate all submittals in RED. Architects and General contractors will be notated in color per their direction.
- G. If hard copy submittals are required, Kitchen Equipment Contractor will furnish all copies to the specified trades as required.
- H. If discrepancies, missing information, or incorrect information occur within the documents, Kitchen Equipment Contractor is to seek clarification or note the need for further direction on submittals. The Kitchen Equipment Contractor is to bid the higher of the discrepancies. *Refer to Section 1.3 SCOPE OF WORK: Subsection D.*
- I. Brochure Format (for regularly manufactured equipment and components):
1. Front and rear protective cover with labeled project name.
 2. Brochure index: Indicate Functional Area/Room number, item number, quantity, description, and manufacturer.
 3. A separate flysheet for each component or item of equipment, indicating item number, name, quantity, manufacturer, optional equipment, modifications, special instructions, and utility requirements. Any equipment or assembly containing more than one buyout sub-assembly or component shall have the second item listed in parenthesis beside the primary item name—for example, Serving Counter (hot food well).
 4. Catalog specification sheet with all options notated on the specification sheet and manufacturer's drawing.
- J. Shop Drawings (Rough-In Drawings):
1. Separate drawing sheets: same size as Contract Drawings (Contract Drawings are not to be traced or reproduced). Submittal drawings are to be provided by Kitchen Equipment Contractor and not copied or reproduced from Contract Documents. Any reproduced submittal drawings will be rejected.
 2. 1/4" scale drawing of fixed/movable food service equipment and prefabricated Walk-in assemblies with itemized schedules.
 3. Special Conditions Drawings, sizing, and locating the following conditions:

- a. Slab depressions, cores, sleeves, or block-outs (walk-in assemblies, drain trenches, piping, etc.).
 - b. Concrete or masonry platforms.
 - c. Pipe sleeves or roof jacks.
 - d. Wall openings or block-outs for pass-through equipment, recessed control panels, in-wall fire-protection system components, etc.
 - e. Blocking grounds or anchor plates required in walls for equipment support/attachment.
 - f. Above-ceiling hanger assemblies for support of exhaust hoods, ceiling-mounted pot racks, etc.
 - g. Access panels in walls or ceiling for service of equipment.
 - h. Ceiling pockets or recesses for unusually high equipment.
 - i. In-wall carriers for wall-hung or cantilevered equipment.
4. Electrical Rough-In Drawing
5. Plumbing and Mechanical Rough-In Drawing
6. Required information:
 - a. All fixed and portable food service equipment shown on Contract Drawings.
 - b. All prefabricated Walk-In Assemblies and Conveyor/Dish Table Assemblies shown on Contract Drawings.
 - c. All general-use and convenience utilities or services indicated on Contract Drawings, including those required by or connected to equipment or devices, not in this Section.
 - d. All Rough-In Drawings: Fully dimensioned from engineering benchmark (column lines, when provided) and finished-room surface to the point of stub-up through floor and stub-out through wall or ceiling for all mechanical, electrical, and plumbing services.
 - e. Connection number/tag system and symbols: Identical to Contract Drawings.
- K. Shop Drawings (Manufacturer's and Fabricator's):
 1. Sheet Size: Identical to Contract Drawings, drawn or plotted at a 1/4" scale for plan view, 1/2" for elevations, and 1 1/2" for sections and construction details.
 2. Included information: The item number, name, and quantity.
 3. Construction details, sections, and elevations to reflect the requirements of the Specifications and Drawings.
 4. Indicate adjacent walls, columns, and equipment.
 5. Indicate plumbing and electrical schematic drawings for equipment such as conveyors, waste systems, self-cleaning exhaust hoods, exhaust hood fire protection systems, and fabricated fixtures with a single electrical or plumbing connection.

6. Mechanical or electrical operating components or products integrated into a fabricated fixture: ventilation and service access required or recommended by the manufacturer, including panel size and location to permit easy lubrication, adjustment, or replacement of all moving parts.
- L. All equipment and engineering rough-in plans sheet numbers are to match the contract documents. All equipment item numbers and engineer item numbers located on the schedules are to match the contract documents. All engineering requirements must be updated to accommodate the provided equipment and match the contract documents. The Kitchen Contractor coordinates any MEP revisions to accommodate the supplied and proposed equipment. The Kitchen Equipment Contractor is responsible for any costs associated with equipment substitution.
- M. Foodservice Design Professionals (FDP) drawings and schedules are not to be copied in any way. Any replicated drawings of Foodservice Design Professionals (FDP) will be rejected.

1.10 SERVICE MANUAL

- A. Three copies bound in 1½" hardback, three-ring binders (as many volumes as required by the scope of the project) with the same data as the brochure after installation (Refer to "Submittal Data"). Provide separate service manuals for each independent area within the project scope (Main Kitchen, Culinary, Concession, etc.).
- B. Each Volume: Section for maintenance of finish materials (e.g., stainless steel, plastic laminates, FRP, Plexiglas, etc.).
- C. Catalog specification sheet and/or manufacturer's shop drawings, including wiring diagrams when applicable.
- D. Each Volume: Index of items, manufacturer's operating/maintenance information, replacement parts data, list of all product warranties, and price lists. Provide the name, title, and address of personnel at each respective manufacturer and service personnel to be contacted for spare/replacement parts and service after the warranty period.
- E. To the greatest extent possible, provide two copies of the manufacturer's instructional video cassettes for operating, maintenance, and equipment service.
- F. Internally subdivide binder contents with permanent page dividers, logically organized by equipment item number or manufacturer name, with tab titling printed under reinforced, laminated plastic tabs.
- G. Electronically submitted manuals must follow the formatting requirements listed above.
- H. **Service Manual to be provided to the owner before kitchen equipment demonstration.**

1.11 VERIFICATION AND COORDINATION OF PROJECT / DATA

- A. Utilities Rough-in Drawings and field verifications are to be completed within four weeks after receipt of notice-to-proceed. Review Contract Drawings and Submittal Data for accuracy and completeness and notify Architect of conflicts and proposed adjustments. Coordinate work with other sub-contractors.
 1. KEC to provide on-site field verification of all underground utilities before pouring concrete for capacity and location and coordinate with General Contractor. Submit a review to Architect and General Contractor. If rough-ins need to be relocated, KEC will compensate other trades for the required relocation.

2. KEC to provide on-site field verification of all other utility connections and locations and coordinate with General Contractor. Submit a review to Architect and General Contractor.

B. On-Site Inspection Reports

1. Before concrete pour: The Kitchen Equipment Contractor is to submit a copy of the report below to the Architect, General Contractor, and Foodservice Design Professionals (FDP) within 24 hours of the inspection. The form to be submitted is contained within these General Specifications.
2. Before delivery of equipment: The Kitchen Equipment Contractor is to submit a copy of the report below to the Architect, General Contractor, and Foodservice Design Professionals (FDP) within 24 hours of the inspection. The form to be submitted is contained within these General Specifications.



On - Site Inspection Report

Prior to Concrete Pour

Inspection Date _____ Project Name _____

Project Location _____

Inspector's Name _____ Company _____

Inspector's Contact Number _____ Email _____

Architectural Firm _____ Project Architect _____

Architect's Contact Number _____ Email _____

General Contractor _____ Project Manager _____

G.C. Contact Number _____ Email _____

Food Service Consultant Foodservice Design Professionals, LLC Project Manager _____

Contact Number 281.350.2323 Email _____

An on-site Inspection to verify the location of UNDERGROUND utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory.

Neither the Architect nor FDP need to be present at these inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE
ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE DESIGN
PROFESSIONALS, LLC.



On - Site Inspection Report

Prior to Delivery of Equipment

Inspection Date _____ **Project Name** _____

Project Location _____

Inspector's Name _____ **Company** _____

Inspector's Contact Number _____ **Email** _____

Architectural Firm _____ **Project Architect** _____

Architect's Contact Number _____ **Email** _____

General Contractor _____ **Project Manager** _____

G.C. Contact Number _____ **Email** _____

Food Service Consultant Foodservice Design Professionals, LLC **Project Manager** _____

Contact Number 281.350.2323 **Email** _____

An on-site Inspection to verify the location of INSTALLED utilities was conducted on this date. The following conditions were observed and brought to the attention of the General Contractor. (KEC is to provide a written description and copy of the Utility Plan indicating the corrective action required).

1. What difficulties were encountered?

Inspector's Initials _____

This Inspection Report is the responsibility of the Kitchen Equipment Supplier and the General Contractor. Coordination between the two parties is mandatory.
Neither the Architect nor FDP need to be present at these inspections.

EMAIL A COPY OF THIS REPORT AND ANY ADDITIONAL INFORMATION TO THE ARCHITECT, GENERAL CONTRACTOR AND FOODSERVICE DESIGN PROFESSIONALS, LLC.

- C. Review critical systems/components for application, performance, and capacity and submit calculation worksheets with the initial submission of brochure/rough-in drawings, with all proposed adjustments noted, including:
1. Exhaust hood removal/supply air volume, velocity, static pressure, duct collar sizes, and locations.
 2. Refrigeration Systems (compressor, condenser, and evaporator) capacities/sizes, quantities, and refrigerant piping distances/sizes.
 3. Exhaust Hood Fire Suppression Systems (nozzle locations, air handler, fuel interlocks, piping/distance limitations).
 4. Locations of Vacuum Breakers.
 5. Conformance of Refrigerated Components/Equipment with HACCP Guidelines (e.g., salad/sandwich pans, upright/open refrigerator cabinets, salad bars) with HACCP Guidelines.
 6. Gas and water line sizes and manifold configurations.
 7. Diameter and length of flexible connector lines for fixed/movable gas appliances.
 8. Fabricated Equipment load center panels (individual and total amperage calculations and circuit balance).
 9. ADA compliance of workstations, service positions, passageways, etc.
- D. Ceiling mounted appliances/fixtures: Verify and coordinate dimensions/location of support framing/hangers with the General Contractor—all material and installation below 12'-0" AFF: Section 11 40 00.
- E. Dimension Responsibility: Obtain actual or guaranteed measurements for the proper equipment fit. All dimensions indicated in Contract Documents are approximate and are as accurate as can be determined at the time. Field-check all horizontal/vertical measurements and conditions at the building before fabrication or delivery of equipment and notify the Architect of all conflicts or deviations from the dimensions shown.
- F. Checking Dimensions at Site: Before ordering any materials or doing any work, verify all measurements of the building and be responsible for their correctness. No extras will be allowed for variations from drawings in existing conditions or work performed under this contract. Any discrepancies found shall be submitted to the Architect for instructions before proceeding.
- G. Scheduling to Fit Openings: Should it become necessary to schedule the construction of walls or partitions before delivery of fixed equipment, the equipment must be fabricated for passage through finished openings. Maintain close contact with the project and be cognizant of all conditions, including vertical handling limitations within the building (elevator cabs or openings, stairs, etc.) and possible hoisting requirements. Coordinate all procedures with General Contractor and Project Team.
- H. Refrigerated and Dry Storage Areas: Verify and coordinate dimensions to accommodate scheduled modular shelf sections. Notify Architect of the variance between the Contract Documents and actual conditions.
- I. Color/Pattern Selections: Submit selection samples of solid polymer products, plastic laminate, paint or stain finishes, and vinyl-coated surface material of equipment as selected by the Owner.

- J. Movable Equipment Interface: Rolling stock (pan racks, carts, dollies, dish/tray/rack dispensers) required to fit through or into fixed equipment (roll-in refrigerators, counter bodies, etc.) is to be reviewed and coordinated for compatibility at the time initial of shop drawing submittal. Indicate conflicts and proposed adjustments.
- K. Relocation of Work: Relocate or re-route work as required to coordinate related items free of charge if no extra work is involved.
- L. **Kitchen Equipment Contractor must provide FDP with the food service equipment lump sum pricing (including material and labor) after the contract has been executed and before submittals are provided to FDP. This information is critical to FDP for accounting/billing purposes.**

1.12 EQUIPMENT FURNISHED / INSTALLED BY OTHERS

- A. Obtain and coordinate utility requirements of Owner-Furnished/Owner-Installed (OF/OI) equipment with the building utilities and rough-in drawings/provisions.
- B. Coordinate physical data of OF/OI appliances or equipment and incorporate information into Submittal Drawings. Vendor- or Purveyor-Furnished equipment (e.g., coffee/tea equipment): same as OF/OI.

1.13 WORK INSTALLED BUT FURNISHED BY OTHERS

- A. Coordinate delivery/installation schedule of Owner-Furnished/Contractor-Installed (OF/CI) equipment with the Owner at least ninety (90) days before equipment requirement.
- B. Obtain and coordinate utility requirements of OF/CI equipment with the building utilities and rough-in drawings/provisions.
- C. Receive at the job site and fully incorporate into installation procedures as if furnished under this Section.

PART 2 - PRODUCTS

A. FABRICATED FIXTURES MATERIAL / COMPONENTS

- A. Stainless steel sheets or shapes: 18-8, Type 302, polished to 180 grit No. 4 finish.
 - 1. Stainless steel joints and seams: Heli-arc welded, free of pits and flaws, ground smooth, and polished to a No. 4 finish.
 - 2. The "grain" direction of horizontal stainless-steel surfaces: Longitudinal, including the backsplash. The polishing procedure at right-angle corners of fixtures shall provide a mitered appearance.
- B. Galvanized Iron Sheets: Armco copper bearing Zinc Grip or Zinc Grip/Paint Grip.
 - 1. Galvanized iron joints and seams: Arc-welded, free of pits, flaws, and ground smooth.
 - 2. Galvanized sheets or shapes: Washed with mineral spirits and painted with Rust-Oleum gray semi-gloss enamel.
- C. Sound Deadening: Schnee Butyl Sealant ½" wide rope positioned continuously between all frame members or contact material and underside of stainless-steel surface (sinks, tabletops,

food wells, over shelves, and undershelves). Tighten stud bolts for maximum compression of sealant and trim excess.

- D. Plastic Laminates: Color/pattern selected by Architect, in 1/16" thickness for flat surfaces: 1/32" thickness for radiused surfaces. Plastic laminates and adhesives must be NSF-approved (Standard No. 35).
- E. Solid Polymer products: Color/pattern/material selected by Architect in thickness as specified. Solid Polymers and adhesives must be N.S.F. approved (Standard No. 51).
- F. Casters:
 - 1. Fabricated fixtures with "Open Base" construction: Jarvis and Jarvis Model No. 5-405-113P-NSF swivel casters with grease seals on forks and wheels; Zerk fitting in swivel; two casters: Model No. E-75 Verti-Lock brakes. All casters: B-7" rolling bumpers with stainless steel top discs.
- G. Cutting Boards: 1/2" thick Read Products, Inc. "Richlite" cutting board, size as indicated.
- H. Identification Plates, Labels, Tags:
 - 1. Prohibited Information: Names of suppliers, fabricators, and contractors.
 - 2. NSF Labels: Required on all pieces of equipment.
 - 3. Required Information: Function or purpose of controls such as display light switches, food warmer controls, etc.
 - 4. Plate Construction: Engraved phenolic plastic, secured to equipment with epoxy cement or stainless-steel screws. Furnish samples.

2.1 PLUMBING / MECHANICAL REQUIREMENTS

- A. Plumbing Fittings and Components: Furnished under this Section as follows:
Note: Fitting and components described in Items 1, 2, 3, 4, and 5 are furnished loose by 11 40 00 for final installation and connection by Division 22.
 - 1. Control valves and appliance pressure regulators for water, gas, steam, and vacuum breakers: wherever required on food service equipment (chrome-plated where exposed).
 - 2. Faucets and drains with and without connected overflows (unless otherwise indicated) for all sinks.
 - 3. Specialty food service water-fill faucets, hose bibbs, or hose assemblies indicated in drawings/specifications.
 - 4. Wade Model No. W-10 Shock-Stop shock absorbers for all food service equipment with quick-opening or solenoid-operated water valves.
 - 5. Dormont Series Water Quick Disconnect hose, diameter per water connection size requirements, with safety fitting, w/coiled restraining device, full port ball valve, antimicrobial coating, lifetime warranty.
 - 6. Extensions of indirect waste fittings to open-sight floor sink or floor drains from sinks, under bar equipment, and food-holding components of serving counters (e.g., cold pans, hot food wells, refrigerator/freezer coils not equipped with condensate

evaporators) furnished and installed by Division 22. Drains: All drains to be type 'K' Copper – Paint with aluminum paint where exposed. **Div. 22 to ensure a minimum air gap of 1" and not less than twice the effective opening of the indirect waste pipe, per code. Div. 22 to ensure all drain lines are centered over floor sink grate openings and no water splashes on the floor.**

7. Piping brackets and supports beneath fabricated equipment.
 8. Closed Base Bodies: Removable 18-gauge stainless steel closure panel at plumbing penetrations under the top.
 9. Control valves on Open Base fixtures: Mounted on a 14-gauge stainless steel gusset-shaped panel with h 3½" setback from the countertop edge/rim to the face of the control handle.
 10. Fill hose/faucet at support pedestals or Closed Base Body: Installed in a 15" x 18" x 5" deep recessed mounting panel. Panel bottom: sloped on a 60° angle, with 3/8" stainless steel rod hanger-bracket for the hose.
 11. Provide filtration option as shown on contract documents (a, b, c, or combination thereof):
 - a. In-line Water Filter System:
 - i. Everpure System filters for coffee/tea brewers, icemakers, water chillers, convection steamers, and beverage systems. They should be sized per the manufacturer's recommendation.
 - b. Remote Central Water Filter System.
 - c. Remote and/or In-line Reverse Osmosis system.
- B. Gas-Heated Equipment Fittings and Components: Furnished under this Section as follows:
1. Fixed Equipment: Dormont 1675KIT2S48 gas appliance connector: Diameter per fuel volume/connection size requirements. Gas valve diameter size per fuel volume/connection size requirements.
 - a. Restraining device: Heavy duty steel cable, fastened to equipment and walls, 3" to 6" shorter than equipment connector length.
- C. Final Plumbing Connections Provisions:
1. Fabricated equipment containing components, fittings, and devices indicated on food service connection drawings to be connected to the building systems: each component, fitting, or group thereof pre-piped to a utility compartment for final connection by Division 22. Refer to drawings for capacities.
 2. Field-assembled equipment (e.g., prefabricated walk-in assemblies, exhaust hoods, ware wash machines, convection ovens, etc.): plumbing components completely interconnected under this Section for final connection arrangements indicated on Utility Connection Drawings.
 3. All plumbing final connection points of equipment shall be tagged, indicating the following:
 - a. Item number

- b. Name of devices or components
- c. Type of utility (water, gas, steam, drain, chilled water)
- D. Ducts and Vents:
 - 1. Exhaust hoods furred-in to ceiling: 2" high duct collar for final connection to the duct system.
 - 2. Warewash machines equipped with integral vent cowls or extended hoods: furnished with 18-gauge stainless steel seamless duct risers to 6" above the finished ceiling for final connection. The duct: trimmed at the ceiling with a 16-gauge stainless steel angle flange with all corners welded.
- E. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Sub Sections E. Plumbing and F. Mechanical for additional information.

2.2 FOOD SERVICE EQUIPMENT REFRIGERATION SYSTEMS

- A. Install complete with all refrigerants, oil, dials, dehydrators, gauges, and controls required for the system's proper operation.
- B. Self-contained or factory-installed compressors: Check and adjust to the proper operating temperature prescribed by FDA/HACCP.

2.3 PLUMBING TRIM

- A. Faucets: Furnished for all sinks or equipment requiring open water supply.
- B. Fill Faucets: Furnished for appliances requiring open water supply.
- C. Drain Fittings: Furnished for all sinks or equipment requiring removal of liquids. Install specified chrome-plated or stainless-steel fittings in die-stamped openings with washers and locknuts. The solder may be used as a sealer but shall not be applied to the top surface of the drain fittings.

2.4 ELECTRICAL REQUIREMENTS

- A. All electrical systems, components, and accessories within the work of this Section: Certified to be in accordance with NEC 70.
- B. Electrical Fittings and Components: Furnished under this Section as follows. Coordinate food service equipment loads, voltage, and phase with the building system and confirm any existing or OF/OI equipment requirements.
- C. Cord and Caps:
 - 1. Coordinate all food service equipment cord/caps with related receptacles.
 - 2. All 120, 120/208, and 208 volts "plug-in" equipment shall have Type SO or SJO cord and plug with ground wire fastened to the frame/body of the item.

3. Cord lengths for fixed equipment: Adjusted to eliminate loose-hanging excess.
 4. All non-fixed plug-in "buy-out" equipment: Hubbell configuration and ratings as required.
 5. All mobile electrical support equipment (heated cabinets, dish carts, etc.) and counter appliances mounted on mobile stands (mixers, food cutters, toasters, coffee makers, microwave ovens, etc.): 8'-0" cord length with cord-hanger strap secured to the rear of equipment or mobile stand.
- D. Switches and Controls:
1. Each motor-driven appliance or electrically heated unit: Equipped with a control switch or starter per Underwriters' Laboratories, Inc., with low-voltage and overload protection.
 2. Disposer controls recess-mounted in the wall: External fittings and accessories removed from the enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 4'-0" AFF to the bottom of the enclosure.
 3. Disposer controls recess-mounted in counter-splash risers: External fittings and accessories removed from NEMA 4 enclosure and furnished with 16-gauge stainless steel perimeter angle flange with welded corners. Install control at 3'-0" AFF to the bottom of the enclosure. Provide the panel with a 60" long Seal-Tite electrical conduit from the bottom of the control panel for final field connections under Division 26.
 4. Equipment that is not provided with built-in circuit breakers or fused terminal block and is indicated on Utility Connections Drawings to be directly connected to the building electrical system: a NEMA 4 stainless steel disconnect switch furnished and installed by Division 26.
 5. All remote manual starters, disconnect switches, magnetic contactors or starters, and push-button stations: NEMA Type 4 enclosure; NEMA Type 1 enclosure only when installed in a Closed Base Body.
- E. Heating Elements:
1. Electrically heated equipment: Thermostatic controls.
 2. Water heating equipment: Equipped with positive low water shut-off.
- F. Receptacles and Switches:
1. Receptacles installed in vertical panels of support pedestals or Closed Base Bodies: installed in 12" x 8½" x 3" deep recessed mounting panel sloped at a 60° angle and turned up to the top of the opening.
 2. Pre-wire receptacles in closed base fixtures to a junction box installed within 6" from the bottom of utility or compressor compartments.
 3. Receptacles mounted on Open Base fixtures: Installed on a 12" x 10½" x 4½" deep 14-gauge stainless steel panel with returned ends and sloping recess—secure panel to the underframe of fixture top.
 4. Pre-wire receptacles on open base fixtures to a junction box secured to a leg or mounted on the underside of the lower shelf. Vertical runs of wiring: Made in rigid conduit or within the tubular leg.

5. Receptacles installed in/on-fabricated equipment: Hubbell, Inc. assemblies horizontally mounted in a metal box with stainless steel cover plate.
6. Switches installed in/on-fabricated equipment: Hubbell, Inc. with metal box and stainless-steel cover plate. Switches: pre-wired to the controlled device and a junction box installed within 6" from the bottom of the utility or compressor compartment. All refrigeration system switches: Installed within the compressor compartment near the door opening.
7. Load centers installed in/on fabricated equipment to have all fixture components pre-wired to the load center with balanced phase loading. Load center: Ready for final connection by Division 26 and flush-mounted within the utility compartment rear panel, set back 8" from the access door. All breaker/device information will be typewritten on the circuit schedule in the load center door (number corresponding breaker/device) with an enclosed schematic wiring diagram of fixture components.
8. All receptacles are to be pre-wired to the cord and plug assembly and routed through the over-shelf post at all island equipment locations unless specified otherwise.

G. Light Fixtures:

1. Light fixtures with lamps installed in/on fabricated or field-assembled equipment: pre-wired to a junction box for final connection (continuous-run fixtures when indicated).
2. LED Display Light: Install light fixtures full-length of Display Stand and Serving Shelf with stud bolts and pre-wire through support posts to an apron-mounted switch.
3. Heat Lamps: Installed to the underside of serving shelf assemblies. When multiple 24" heat lamps are specified, provide maximum length heat lamp chassis. Install all switches remotely from lamps.
4. **Walk-in assembly LED Light Fixtures: Furnished by Section 11 40 00, final installation by Div. 26. All electrical wiring and conduit, provided by Div. 26, electrically connected through the Vapor Proof light fixture base connection, located on the interior door header—all Conduit to be EMT Watertight. Door frame wiring stubs out the top of panels 8" in flexible conduit for final connection by the electrical contractor. All horizontal conduits: below ceiling panels. All lighting fixtures will be wired from inside the assembly—no penetrations through the ceiling panels. Seal-sleeved penetrations are airtight at both sides of the panel. KEC is responsible for verifying that trade contractors seal all penetrations.**

H. Final Electrical Connection Provisions:

1. Fabricated equipment containing electrically operated components or fittings indicated on Utility Connections Drawings: Direct connected, with each component, fitting, or group pre-wired to a junction box for final connection by Division 26. Refer to drawings for circuit loading.
2. Fabricated equipment containing electrically operated components and devices indicated: Circuit-breaker load center with each component or device pre-wired to a separate circuit breaker for balanced phase loading and single final connection by Division 26.
3. Field-assembled equipment (e.g., prefabricated walk-in assemblies, exhaust hoods, ware wash machines, etc.) shall have electrical components completely interconnected in this Section for final connection arrangements as indicated on Utility Connection Drawings by Division 26.

4. Pre-wire the following groups of walk-in assembly electrical devices to a top-mounted junction box for final connection by Division 26 per compartment grouping (unless otherwise indicated).
 - a. Light fixtures and switches; heated pressure-relief ports.
 - b. Door/jamb heaters.
 - c. Evaporator fans, defrost elements and drain line heaters.
5. All electrical final connection points of equipment shall be tagged, indicating the following:
 - a. Item number.
 - b. Name of devices on the circuit.
 - c. Total electrical load.
 - d. Voltage and phase.
- I. Lamps: in all food service equipment containing light fixtures. Refrigerator or heated cabinets: All exposed LED lamps above or within a food zone: Shat-R-Shield lamps or standard lamps, sleeved with end caps.
- J. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsection F. Division 26 (Electrical) for additional information.

2.5 CUSTOM – FABRICATED / ASSEMBLED UNITS

- A. Mechanical or electrical operating components or products integrated into a fabricated fixture: Ventilation and service access required or recommended by the manufacturer. The size and placement of the service access panel(s) permit easy lubrication, adjustment, or replacement of all moving parts and are to be indicated on fabrication shop drawings.

2.6 BAKER TABLETOPS (Unless specified otherwise)

- A. 14-gauge 304 S/S top with 2" square turn down at the front, 6" high enclosed splash at two (2) sides and rear. Brace same as "Counter/Tabletops."
- B. 1¼" x 6" high integral coved riser at rear and ends unless indicated otherwise on drawings.
- C. 16-gauge stainless steel flour-trough at free long sides, secured to the underside of the top. Trough: 3" diameter with eased edges/corners.

2.7 COUNTER / TABLETOPS

- A. 14-gauge stainless steel; all free edges turned down 2" with ¾" tight hem at the bottom—free corners: rounded on ¾" radius.
- B. Marine edges: Turned up ½" on 45° angle and turned down 2" with ¾" tight hem at the bottom.
- C. Cafeteria serving countertops at hot food stations: Full-length x 3½" x ½" high raised rail at (customer's) front side with 45° integral turndown to counter surface.

- D. Tops abutting high fixtures or walls: Cove up specified height and slope back 1½" at the top on 45° angle; 2½" slope where piping occurs. Turn down 1" at the rear of the splash and tight ends to the bottom of the top turndown. Secure splash turndown to the wall with a 4" long 14-gauge stainless steel "Z" clip anchored to the wall, 36" OC.
- E. Freestanding tables and all serving counter splash-risers: Turned back at a 90° angle with 1" turndown at the rear.
- F. Brace tops with rigid-welded 1½" x 1½" x 1/8" galvanized steel angle frame at the perimeter with cross bracing 2'-0" OC maximum. Provide 4" x 4" x 12-gauge stainless steel triangular pads where leg gusset welds to frame. Paint the entire frame with Rust-Oleum gray semi-gloss enamel. Angle frames: Secured to the underside of top surfaces with ¼" studs welded 9" OC maximum with chrome-plated washer, lock washer, and cap nut. Studs: Such length that cap nuts can be made up tight, bringing the top down snugly on the angle frame, eliminating all vibrations or "oil-canning."
- G. Tops: 1½" overhang at free sides of underframe or Closed Base Body.
- H. Mockett Model No. SG5-26 chrome-plated/plastic grommet assembly or integrally welded stainless-steel flange or inverted gusset where service utilities or support posts penetrate or abut tops, ground, and polished to match the top. When conditions permit, provide a 1" x 1½" rectangular backsplash opening for service utilities instead of piercing the horizontal surface. Install stainless steel split tubing at the raw edge of the opening.
- I. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on leg/bracket assembly.
- J. All openings in tops: 3/16" high raised die-formed edges.
- K. All top openings for pans or inserts: 20-gauge stainless steel, watertight liners, 8½" deep, secured to the underside of the countertop.
- L. All "built-in" and "drop-in" counter equipment/appliances to have framing members at the perimeter of the opening.
- M. Scrap Basket: 18-gauge stainless steel construction 6½" x 6½" x 21¾" long. Top of container: 5/8" wide x ¼" high full perimeter flange with ¼" diameter stainless steel rod bail handle. Interior vertical corners coved on ½" radius. Countertop: Fitted with 6¾" square die-stamped opening.

2.8 COLD PANS

- A. 14-gauge stainless steel with ¾" coved interior welded integrally to the countertop with a 3/16" raised edge at the perimeter of the opening – depth of cold pan to follow NSF 7 compliance.
- B. Slope bottom to required quantity of Component Hardware Model No. E16-4021 drain fittings at 48" OC maximum. Sleeve through insulation at drain fittings and extend common drain line into utility compartment for indirect waste connection.
- C. ½" OD copper refrigerant lines in a serpentine pattern, 1½" OC flattened for maximum contact. Secure tubing to the underside of ¼" thick aluminum "distribution plate" installed tight to the underside of the frost plate area and apply cold-conductive mastic to all surfaces.
- D. Component Hardware Model No. E16-4021 drain fittings at 48" OC maximum, sleeved through the insulation with common drain line extended into utility compartment.

- E. Heat Cable: Low-wattage, full-perimeter, below countertop at the edge of depression. Secure with "Z" clips, 9" OC, and interwire with compressor switch for simultaneous operation.
- F. Enclose the sides and bottom of pans with an airtight 18-gauge galvanized jacket and pack with 2" fiberglass insulation set in mastic.
- G. Compressor: Size as indicated or required to accommodate the size of the cold pan. Locate the compressor in the compartment below the unit or as shown on the drawings.
- H. Sectional 16-gauge stainless steel perforated false bottom ($\frac{1}{4}$ " holes, @ $\frac{3}{4}$ " OC). Turn down $1\frac{1}{2}$ " on all sides, weld corners, and provide finger rings. False bottom sections: 24" long maximum.

2.9 DRAWERS

- A. Stainless Steel Liners: Component Hardware Model No. S81-2020C (20" x 20"), easily removable with drawer in the fully extended position.
- B. Drawer Frame: 16-gauge stainless steel flanged out at the top. Weld the frame to a double-panel 16-gauge stainless steel drawer front with full-length recessed pull at the top (similar profile as Garco Model No. R-1060) with closed ends.
- C. Channel-formed horizontal pull: $\frac{3}{4}$ " turndown at the front and ends with $\frac{1}{2}$ " tight hem. The front edge of the pull: flush with the face of the drawer. Recess behind pull: sloped up on a 60° angle, terminating 1" below the bottom edge of pull.
- D. Mount drawer frame on Component Hardware Model No. S52-2020 self-closing slides, with Delrin bearings, full-depth of the fixture. Secure slides to the body or brackets to eliminate lateral movement in the extended position. Refrigerator drawers: Component Hardware Model No. S52-2024 stainless steel slides with Delrin bearings.
- E. Drawer enclosure in an Open Base Fixture: 18-gauge stainless steel flanged out at the top for attachment to the underside of the tabletop. The lower edge of the enclosure is flanged in toward the open bottom. Mount drawer slides to enclosure and brace as required. The face of the enclosure is to be the same length and height of the drawer face. Provide $\frac{3}{4}$ " deep offset in front of the enclosure and $2\frac{1}{2}$ " from the underside of the tabletop for a flush-fitting appearance.
- F. Drawer enclosure on freestanding fixture: Full depth of table framing.
- G. Drawer enclosure in a Closed Base Fixture: Completely partitioned from the adjoining area. Drawer front: Flush fitting with the face of the body.
- H. Drawer Liners other than tool/utility: **Bread Drawer:** S/S liner sized to fit drawer; **Refrigerated Drawer:** S/S liner sized to fit drawer.
- I. Cash Drawer: Integral stainless-steel body, 3" deep.

2.10 FOOD WELLS (UNLESS SPECIFIED OTHERWISE)

- A. Food Warmer Controls: Remote-mounted in sloping recessed apron panel. The control panel is recessed $2\frac{1}{2}$ " from the bodyline at the top of the 60° slope and 1" at the lower edge. Terminate slope angle $2\frac{1}{2}$ " below the countertop. Mount panel on concealed piano hinge at bottom edge; secure with screws at upper corners.
- B. Manifold all warmer drains and extend to within the utility compartment for indirect waste connection. Install valve in the drain line and extend handle through compartment door.

- C. Removable 18-gauge stainless steel closure panel at the underside of warmers.
- D. 14-gauge stainless steel plate/utensil shelf full-length of hot food station unless noted otherwise: 10" below countertop x 9" deep, with rear panel covered up to the underside of the countertop; end panels turned up square. Front of shelf: Turned down 1½" and returned under for closure panel attachment.
- E. Food wells: Hatco Model No. HWBIBRT-FULD insulated food warmer (1200 watts, 208 volts, single phase) secured to the underside of 12" x 20" die-stamped countertop openings with thermal breaker mastic rope applied at the perimeter of food well flange.
- F. Soup Warmers: Hatco Model No. HWB-11QTD soup warmer secured to the underside of 11" diameter die stamped countertop opening with thermal breaker mastic rope applied at the perimeter of soup well flange. The maximum allowable temperature of the countertop at the contact surface is: 120°F. Each warmer: Equipped with one 11-quart stainless steel round insert and slotted cover.

2.11 SINKS

- A. 14-gauge stainless steel; all interior corners (horizontal/vertical) coved on ¾" radius. 1½" wide double-walled partitions with flat tops between compartments.
- B. Continuous exterior panels of multiple-compartment sinks: 14-gauge stainless steel filler panel welded ground and polished between compartments.
- C. Sinks (with overflow): Score and slope sink bottom ½" to die-stamped opening fitted with Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. 18-gauge stainless steel bracket: Welded to sink bottom for drain stem with 1½" handle clearance.
- D. Where sinks are installed in fixtures with Closed Base Body, provide a Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. (Sinks with dimensions larger than 20" x 20" in Closed Base Body will not have overflow fitting.) 18-gauge stainless steel bracket: welded to sink bottom with T & S Model No. BL-4740-1 guide bushing. Install on shortened drain stem, one T & S Model No. BL-4710-1 remote control stem assembly only (length as required) with Model No. 113-L universal joint and white blank button. Set drain control handle in Cambro Model PSB-6 bowl with bottom omitted (dress raw edge) to permit passage of drain handle—secure bowl in utility compartment door or body panel with clear silicone.
- E. When single-hole deck-mounted faucets are specified, install overflow fitting in the sidewall of the sink compartment and provide ell-fitting in connecting tubing.
- F. Flush Covers when specified: 1/2" thick Read Products, Inc. "Richlite" cutting board with two (2) finger holes, size as indicated. Support clips: ¼" stainless steel rod 2" long, formed at 45° with two ¾" leg ends (¼" long threaded ends). Insert rod clips through tight-clearance holes in the sink, seal watertight, and secure with stainless steel acorn nuts or tack-weld at the exterior of the sink wall. Set support clips ½" below the top. Provide a 14-gauge stainless steel channel or angle support frame to store covers when not in use. Cover holder: Adjacent to sink compartment, below countertop, or under drawer assembly.

2.12 TRAY SLIDES (UNLESS OTHERWISE SPECIFIED)

- A. Tray slides: 12" wide, solid 14-gauge stainless steel turned up 2" at the rear behind countertop turndown; turned down 4" at the front and free ends unless otherwise indicated.
- B. Three ¼" high die-formed inverted "V" ridges at 4" OC, 2" from the leading edge, terminating 2" from ends of tray slide with tapered ridge ends.

- C. Ridges formed on radius: Equal-length segments with 2" separation between chords.
- D. Secure tray slides to countertop/body frame, same as "Countertops." Enclose the exposed underside of the tray slide with 18-gauge stainless steel.
- E. When indicated, project tray slides 2" beyond the serving countertop and return the entire width of the serving counter at free ends.
- F. All tray slides are to be provided and mounted per ADA requirements.

2.13 DISHTABLES

- A. Soiled/clean dishtable: 14-gauge stainless steel; free edges coved up 3" with 1½" diameter rolled rim and bullnose corners.
- B. Edge of dishtables next to high fixtures or walls: Coved up 10" and sloped back 1½" on 45° angle; 2½" slope where piping occurs. Turn down 1" at the rear of splash and secure to wall with 4" long 14-gauge stainless steel "Z" clips anchored to the wall, @ 36" OC.
- C. Exposed rear splash: 16-gauge stainless steel finish panel from the top of the splash to the bottom edge of the rolled rim with a welded vertical joint at the end. Secure the panel with concealed attachment and install bracing 24" OC.
- D. Cove all interior corners (horizontal/vertical) on ¾" radius and slope tables 1/8" per foot to sinks, scuppers, or ware wash machines, maintaining level crown/splash.
- E. Brace dishtables with 1" x 4" 12-gauge stainless steel channels down the top centerline and between each pair of legs, with closed ends. Bracing: secured to the underside of the dishtable with ¼" studs welded 6" OC maximum, with chrome-plated washer, lock washer, and cap nut. Studs: such length that the cap nuts can be made up tight, bringing the dishtable down on the channel members, eliminating all vibration and "oil-canning."
- F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops; ground and polished to match the top.
- G. Hose Bibb: Chicago Model No. 305VBR CF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose hanger.
- H. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on leg/bracket assembly.
- I. Paper-Drop Opening: 9" square with 4" integral chute having hemmed bottom edge. Slope dishtable top 1" toward the opening, forming a 16" square tapered deposit point.
- J. Accessible Tray-Drop Opening: 10" x 18" with integral 16-gauge stainless steel seamless chute sloped at 45° angle toward the center of mobile soak sink position.
- K. All dishtables with a Conveyor Type Dishmachine must have a table limit switch provided by Manufacturer and installed by Division 26. Prepare clean dishtable with holes for table limit switch and provide s/s back cover. Wiring must be concealed within dishtable fabrication.

2.14 DISH / TRAY DEPOSIT ASSEMBLY

- A. 14-gauge stainless steel deposit shelf, size as indicated. Extend the frame through the opening, flush with the public side of the partition, height as local code authorities require.

Turn the shelf down 1" at the front with $\frac{3}{4}$ " return at the bottom (either scribed into a partition or forming reveal). Shelf: 1" square turndown at the long rear side, integral with conveyor slider pan, tray-accumulator, or dishtable. Extend the rear/end splash to align with the head of the deposit station opening. Modify rolled rim at the operator's side of the tray drop window to have a 3" rolled rim.

- B. 18-gauge stainless steel window frame with perimeter flange channel-formed 1" x $\frac{3}{4}$ " at both wall sides. Weld all corners of the frame and install with concealed attachment. Align/about one jamb of the frame with end splash of conveyor slider pan or dishtable whenever adjacent.

2.15 UTENSIL – WASH COUNTERS

- A. 14-gauge stainless steel; all free edges coved up 3" with 1½" diameter rolled rim and bullnose corners.
- B. Edges of utensil-wash counters next to high fixtures or walls: Coved up 10" and sloped back 1½" on 45° angle; 2½" slope where piping occurs. Turn down 1" at the rear of splash and secure backsplash to the wall with 4" long 14-gauge stainless steel "Z" clip anchored to wall @ 36" OC. Vacuum breaker pockets: 4" long square turnback sections aligned with the slope break line.
- C. Exposed Rear Splash: 16-gauge stainless steel finished panel from the top of the splash to the bottom edge of the rolled rim with a welded vertical joint at the end of the splash and ½" turnback at the bottom of the panel. Secure the panel with concealed attachment and install bracing 24" OC.
- D. Cove all interior corners (horizontal/vertical) on $\frac{3}{4}$ " radius and slope tables 1/8" per foot, maintaining level crown.
- E. Brace utensil-wash counters with 1" x 4" 12-gauge stainless steel channels down the centerline of the top and between each pair of legs, with closed ends. Bracing: Secured to underside of dishtable with $\frac{1}{4}$ " studs welded 6" OC. maximum, with a chrome-plated washer, lock washer, and cap nut. Studs: Such length that the cap nuts can be made up tight, bringing the dishtable down on the channel members, eliminating all vibration and "oil-canning."
- F. Integrally welded stainless steel flange or inverted gusset where service utilities or support posts penetrate or abut tops: ground and polished to match the top.
- G. Extend underbracing members to the wall, turn down 6", and anchor to the wall when specified to be mounted on a leg/bracket assembly.
- H. Hose Bibb: Chicago Model No. 305VBRCF; mounted on 12-gauge stainless steel flange or inverted gusset bracket with 3/8" stainless steel rod hose hanger.

2.16 DOORS

- A. 18-gauge x 1" stainless steel double pan-formed welded construction, insulated with 1" thick polyurethane boards. Seal the perimeter joint of the pans. Offset the lower horizontal framing member of the Closed Base Body to align the flush access door with the bottom of the Body.
- B. Channel-formed full-length horizontal recessed pull: $\frac{3}{4}$ " turndown at the front and ends with ½" tight hem. The front edge of the pull: Flush with the face of the door. Recess behind pull: Sloped up on a 60° angle and terminated 1" below the bottom edge of pull.
- C. Door Hardware

1. Two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge location).
 2. Component Hardware Model No. 35-2000 Concealed Magnetic Catch.
 3. Component Hardware Model No. D30-4780 lock in the upper free corner of the door.
- D. Louvered opening: Cut-out opening size as indicated, turn in 1", and weld. All corners: Ground and polished.
1. Full-height 18-gauge stainless steel louver with 1" vanes at 45°, ½" spacing. Perimeter channel-formed frame: 1½" x 1".
 2. 45° x 1" x ½" x opening width plus ½" 18-gauge stainless steel louver.
 3. Tack the louver flange's weld tab to the door's back panel.
- E. Drain handles opening: 6" diameter hole through the double pan to accommodate Cambro Model No. PSB-6 Bowl:
1. Secure the bowl to the door panel with clear silicone.
 2. Omit the bottom of the bowl. Dress raw edges of opening for passage of drain handle.
 3. Exposed insulation at the penetration of the door pan: Painted black.
- F. Sliding Doors: fabricate same as Paragraph "A."
1. Aluminum Sliding Door Track: Component Hardware Model No. B57-0000 Series, length as required. Secure to angle frame at the top of the underside.
 2. Front/rear door sheaves: Stainless steel ¾" side-mounted door hangers; two (2) required per door.
 3. Recessed Vertical Pull at Upper Corner of Door: Component Hardware Model No. P63-1012.
 4. By-Passing Door Guides secured to bottom shelf: Component Hardware Model No. B62-1093.
 5. Door Stop at the bottom edge of door: Component Hardware Model No. B60-1086.
- G. Offset the lower horizontal framing member of the Closed Base Body/utility compressor compartment to align the door flush with the bottom of the Body.

2.17 CLOSED BASE BODIES

- A. Frame: Rigid-welded 1½" x 1½" x 1/8" galvanized steel angle forming a continuous structure around the top and bottom perimeters of the fixture, a post at each corner, studs spaced 48" OC maximum. The top of the frame is cross-braced with 1½" angles, 2'-0" OC maximum.
- B. 18-gauge stainless steel panels and trim with concealed attachment. All seams: Welded, ground, and polished.
- C. Exposed Vertical Corners: Rounded on ¾" radius. Closed Base Bodies adjacent to walls or fixtures: square corners.

- D. Vertical and horizontal channel members at shelf interior or drawer enclosures, such as corners and center mullions: Closed and sealed.
- E. Closed Base Bodies set on finished masonry platforms: closed and caulked at the underside of equipment overhang and bolted to the platform. Body overhang of the platform: 1" at free ends and 2" at the front and exposed rear sides.
- F. Closed Base Bodies not set on the platform: Component Hardware Model No. A54-2-6, 6" legs spaced 4'-0" OC maximum.

2.18 COMPRESSOR COMPARTMENTS

- A. Same material as Closed Base Bodies with back and end partitions; omit bottoms only.
- B. 10-gauge steel slide-out support: Channel frame on full extension slides with 125 lb. minimum capacity secured to fixture frame with anti-vibration mountings for maximum sound deadening. Closed Base Body on the solid platform: front-to-back slide-out support channels set 4" above the bottom for air circulation.
- C. Access Door: 18-gauge stainless steel double-pan type with a channel formed horizontal recessed pull full length of the top (similar profile as Garco Model No. R-1060) with closed ends. Channel-formed horizontal pull: $\frac{3}{4}$ " turndown at front and face of the door. Recess behind pull slopes up on a 60° angle, terminating 1" below the bottom edge of pull. Offset the lower horizontal framing member of the Closed Base Body to align the flush access door with the bottom of the body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and Component Hardware Model No. 35-2000 concealed magnetic catch.
- D. Access Doors Louver: Full-height, with 1½" x 1" x 18-gauge stainless steel channel-formed frame with welded corners. 18-gauge stainless steel louver. Submit a sample of the design for approval.

2.19 UTILITY COMPARTMENTS

- A. Closed Base Bodies or Pedestal Supports: Fitted with utility compartments wherever piping or wiring is required in/on the fixture.
- B. Same material as Closed Base Bodies with full-height back and end partitions. Omit bottoms except at hose-reel locations.
- C. Access Doors: 18-gauge stainless steel double-pan type with a channel formed horizontal recessed pull full-length of the top (similar profile to Garco Model No. R-1060) with closed ends. Channel-formed horizontal pull: $\frac{3}{4}$ " turn down at the front of the door, a recess behind the pull slopes up on a 60° angle, terminating 1" below the bottom edge of the pull. Offset the lower horizontal framing member of the Closed Base Fixture to permit flush alignment of the door with the face and bottom edge of the body. Door hardware: two Component Hardware Model No. M75-1002 stainless steel hinges (notch door/jamb at hinge locations) and one Component Hardware Model No. 35-2000 concealed magnetic catch.
- D. No shelves of Closed Base Fixtures are to be penetrated.

B. UTENSIL RACKS

- A. Rack: $\frac{1}{4}$ " x 2" 300 series stainless steel flat bar with No. 4 finish, fully welded and formed to match the shape shown on drawings. Lowest band - 7'-6" AFF unless otherwise indicated.

- B. Ceiling Mount Supports 1-5/8" diameter 16-gauge stainless steel tubing from band to 18" above the ceiling. Anti-sway bracing above the ceiling - 1½" Unistrut members. Tubing penetrations at the ceiling - Component Hardware Model No. A16-0206 stainless steel gussets.
- C. Table Mount Supports 1-5/8" diameter 16-gauge stainless steel tubing extended through countertop. Secure to closed base framing or cross rail/undershelf on the open base fixture. Tubing penetrations of countertops - integrally welded stainless steel inverted gusset.
- D. Utensil Rack Hooks - Component Hardware Model No. J77-4401 stainless steel hooks spaced 8" OC maximum.
- E. Electrical Receptacle: NEMA No. 5-20-R or as noted. Mount in fully welded 3½" x 5½" x 3" 14-gauge stainless steel enclosure with ½" radius corners. Stainless steel cover plate to fit specified receptacle. Pre-wire through tubular support for final connection above the ceiling by Division 26.

C. CASHIER / SERVING COUNTERS

- A. Exterior Body Panels, when specified: ¾" thick marine grade hardwood plywood with plastic laminate or solid polymer in Architect's selection of color/pattern at all exposed surfaces; backing sheet where concealed.
- B. Position, size, and finish horizontal or vertical reveal as Architect directs.
- C. Secure panels to counter body framing in a concealed manner. Install removable panels with "Z" clips overlapping body framing members.
- D. Hinged doors in exterior body panel(s) - Grass Model No. 1200VZ or 1200VZ8 self-closing hinges. Three (3) required per door; Grass Model No. G/HRZ base plate at each hinge; Ives Model No. TM820 concealed push latch at each door. Confirm Model No. and provide samples with the submittal.
- E. Cashier counter to have 16-gauge s/s intermediate shelf, turned down 1 1/2" with tight hem at front. Cove up 2" at rear and sides. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at the longitudinal centerline. Provide an outlet for power/data within the body above the intermediate shelf. Provide cash drawer inserts per district standards.
- F. Sneeze Guards to be adjustable and meet NSF standards.

D. OPEN BASE STRUCTURES

- A. 1-5/8" OD x 16-gauge seamless stainless-steel tubing legs beveled at the bottom. 1¼" OD cross rails fully welded (360° smooth and polished) to legs at 10" AFF, OC.
- B. Top of Leg: Inserted in Component Hardware Model No. A20-0206 gusset fully welded to table frame or sink bottom.
- C. Bullet Foot: Component Hardware Model No. A10-0851.
- D. Freestanding fixtures requiring utility connections: Component Hardware Model No. A10-0854 flanged feet at the fixture corners, anchored to the floor with non-corrosive bolts.
- E. Table Bases: Maximum leg spacing of 6'-0" OC; dishtable and utensil wash counter bases at 5'-0" OC.

- F. Open Base equipment specified to be supported by brackets at the rear side only (not completely cantilevered): Tubular legs at the front side only with Component Hardware Model No. A10-0854 flanged feet anchored to the floor with non-corrosive bolts. Front-to-back cross rail: fitted into Component Hardware Model No. A20-0406 circular gusset secured to the wall with non-corrosive bolts.

E. UNDER SHELVES

- A. Open Base Structures: 16-gauge stainless steel turned down 1½" with tight hem at the bottom. Notch all corners to fit tubular legs and weld from the underside to fill the gap, grind, and polish. Cove up 2" at the rear or ends adjacent to wall, columns, refrigerators, etc. The turn-up at freestanding fixtures is to be hemmed tight to the bottom of the turndown. Brace undershelf with 1" x 4" 14-gauge stainless steel channel at the longitudinal centerline and each intermediate pair of legs.
- B. Open Base Structure specified to be supported by brackets at the rear side only (not completely cantilevered): 16-gauge stainless steel turned down 1 ½" at free sides with tight hem at the bottom edge. Notch all corners to fit tubular legs as required and weld from the underside to fill the gap, grind, and polish. Cove up 2" at rear ends, as indicated. Fill the gap at the front-to-back rail, grind, and polish. Brace undershelf with 1" x 4" x 1" 14-gauge stainless steel channel at longitudinal centerline between front to back rails.
- C. Closed Base Fixtures: 16-gauge stainless steel turned down 1½" at front. Front edge of bottom shelf: Turned back and sealed to finished masonry platform or boxed for leg application. Center shelf has ¾" tight hem.
 - 1. Shelves: Turn up square at ends (coved up at rear only) to the shelf above or countertop flanged out for attachment with no open spaces at interior.
 - 2. All shelf partitions at exposed ends of cabinet bodies or interiors: Free of exposed framing members.
 - 3. Reinforce shelves with full-length 1" x 4" x 14-gauge stainless steel closed hat channel.
 - 4. Unless otherwise noted, all closed base undershelves must be 22" deep and clear.
 - 5. Fully weld smooth and polish the vertical seam of the shelf turndown/turn up with the face of the body partition.
 - 6. Seal the vertical seam of the square turn-in at the exposed interior of open shelf sections.

F. ANCHOR PLATES / WOOD GROUNDS

- A. Behind the finished surface, wherever building walls, partitions, or ceiling construction will not accommodate direct attachment of equipment such as over shelves, wall cabinets, hose reels, utensil racks, exhaust hoods, display cases, etc. Material and installation by General Contractor. Location and coordination with trades by Section 11 40 00.
- B. Anchor Plates: Not less than 12" x 12" x ¼" thick steel, secured to the structure above or behind the finished surface, positioned at attachment points.
- C. Wood Grounds: Length required by fixture, component, or device, 24" wide x ¾" thick plywood secured to partition system before gypsum board installation.

- D. Above ceiling supports: Structural shapes (4" x 8.0 lb. channel) suspended from the structure. Maximum height 15'-0" AFF. Size: width of equipment x length of equipment plus 6'-0". Cross bracing at 6'-0" OC maximum.

G. OVER SHELVES

- A. 16-gauge stainless steel with free edges turned down 1" with $\frac{1}{2}$ " tight hem at the bottom— $\frac{3}{4}$ " radius at free corners.
- B. Turn up 2" raw at walls and sides with a horizontal coved corner at the rear. Round front corners of turn up on $\frac{3}{4}$ " radius.
- C. Where shelf width exceeds 12" width, reinforce with $\frac{1}{2}$ " x 4" x 14-gauge stainless steel closed hat channel full-length of the shelf.
- D. Wall-Mounted Shelves: 16-gauge stainless steel brackets 48" OC maximum, set in 6" from ends.
- E. Freestanding Shelves: Where splash is required at free over shelves, turn up square 2" at ends, cove up at the rear, and hem tight to lower edge of front turndown. Weld exposed corners.
1. Freestanding over shelves: 16-gauge stainless steel cantilevered brackets at the rear of the table; double-cantilevered brackets at the center of the table. Posts for cantilevered over shelves are 1-5/8" OD x 16-gauge stainless steel secured to the underframe, 4'-0" OC. Ends of shelves: Secured to adjacent wall/fixture or mounted on 1 $\frac{1}{4}$ " diameter stainless steel posts.
2. Freestanding over shelves not on cantilevered brackets: 1 $\frac{1}{4}$ " OD x 16-gauge stainless steel posts, each pair at 4'-0" OC maximum.
- F. Baker Table Over shelves: Supported 18" above the top with 1 $\frac{1}{4}$ " OD stainless steel tubular supports with channel shoe secured to risers.
- G. Glass/Cup Rack Over shelf at Dishtables: 14-gauge stainless steel with 1 $\frac{1}{2}$ " deep "vee" trough at free long sides with 1" tight hem inside the trough. Provide a $\frac{1}{2}$ " marine edge at free ends and; a 4" splash at the wall. Suspend shelf at 18" above dishtable surface on posts/brackets anchored to dishtable frame/wall at rear; 1" OD stainless steel tubing supports from the structure above the ceiling at front edge, 60" OC at each end.
1. Install at both ends a $\frac{1}{2}$ " stainless steel drain tube (connecting both vee-troughs) extended to the dishtable surface through splash turnback.
2. Rack-rest: horizontal full-length 1-5/8" OD stainless steel tubing supported at 10" OC above shelf (8" OC for double service shelf) by 1 $\frac{1}{4}$ " OD stainless steel tubing with closed ends. Support tubing: welded, ground, and polished, spaced 60" OC.
3. Rack-rest supports to wall: 4" x 4" x 10-gauge stainless steel flange plates welded to support tubing. Anchor flanged plates to blocking ground with non-corrosive bolts.

H. DRAIN TRENCH LINER / GRATING

- A. Liners: 14-gauge stainless steel in sizes as indicated.
- B. Interior of liners: 6" deep with all interior corners (horizontal/vertical) coved on $\frac{3}{4}$ " radius; sloped and scored 1" to integrally welded Component Hardware Model No. D34-Y011 basket

drain assemblies @ 48" OC, fitted with 6" long welded tailpiece. Stainless steel safety chain: connected to basket strainer assembly and top of liner wall.

- C. Liners: 1" wide perimeter shoulder at the top, turned up flush with finished floor, tight hemmed back down to the shoulder level, and flanged out 2" for attachment to the slab.
- D. Underside of sloping liner portion: 2" long "Z" clips.
- E. Grating: IMC-TEDDY PFD-ADA removable fiberglass grating:
 - 1. 1" deep "I" bearing bars with 0.6" wide top flange.
 - 2. Full perimeter frame, section quantities, and sizes indicated.
 - 3. Maximum of 2'-0" sections.
 - 4. Grating bars should be spaced 0.4" apart per ADA requirements.
 - 5. Grating to be two (2) equal sizes.

I. WALL PANELS

- A. Wall Panels: 18-gauge stainless steel, double pan-formed ½" thick with internal stiffener members. Fill with USDA-approved thermal insulation, full height, and width of panels, and attach to the interior with mastic. The maximum allowable temperature at the rear side of the panel: is 120°F.
 - 1. Height of panels as required: Top of tile base to the underside of the hood, top of tile base to the top cap of stub wall, or top of splash to the underside of the hood.
 - 2. Level and square lower edge and sides.
 - 3. Butt joints on all panels.

J. EXHAUST HOODS (SURFACE-MOUNTED CONDENSATE)

- A. Hoods: Size/shape as indicated: 18" high on the interior.
- B. Body: 16-gauge stainless steel, with all seams welded, ground, and polished.
- C. Continuous condensate trough at perimeter: 3" x 1".
- D. Frame the top of the hood with 1½" angle iron assembly and suspend from the structure above the ceiling by ½" diameter steel rods, drawn tight against the finished ceiling surface.
- E. Duct opening/collar as specified with stainless steel louvered grille over the opening.
- F. Div. 22 to extend drain line to floor sink when shown. The drain line is to be silver painted. Div. 22 to ensure all drain lines are centered over floor sink grate openings and no water splashes on the floor.
- G. ½" diameter steel hanger rods at 4'-0" OC maximum to be by Kitchen Equipment Contractor, but they are to be anchored to the supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
- H. Hoods and components to meet all NSF standards, NFPA 96, UL 710 and current IECC requirements.

K. EXHAUST HOODS (UNLESS SPECIFIED OTHERWISE)

- A. Exhaust to be provided to meet all current local jurisdiction mechanical and energy code requirements. Kitchen Equipment Contractor to verify code requirements and coordinate with Divisions 23 and 26. Hoods over production equipment to be Type 1 with continuous capture. All Type 1 hoods should be 6' deep to ensure smoke/steam capture unless otherwise noted.
- B. Install fire suppression system(s) in all ventilators specified in this section. Install per the manufacturer's recommendations and applicable codes or standards. Submit installation certification form to Architect.
- C. Locate chemical cylinders as indicated on drawings and install piping to exhaust hood(s) in a concealed manner. Set cylinders and cabinets at 7'-0" clear AFF unless noted otherwise. Provide polished chrome plated tubing piping/fittings, where exposed at cylinder location and at the interior of exhaust ventilator—exposed pipe threads in/above the food zone are not allowed. Submit a schematic installation diagram and confirm critical distances from cylinders to nozzles.
- D. Remote manual release located in the path of egress from the protected exhaust hood area. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements before submittal review. All conduits will be recessed within the wall; SURFACE MOUNTING WILL NOT BE ACCEPTED.
- E. Provide one (1) handheld Type 'K' and ABC 6-liter fire extinguisher per Ansul system, surface wall mounted.
- F. Required quantity and sizes of mechanically operated gas valves.
- G. Confirm interconnection of all equipment as required to ensure exhaust hood and fire suppression systems are entirely operational and meet local jurisdiction code requirements.
- H. 1/2" diameter steel hanger rods at 4'-0" OC maximum to be by Kitchen Equipment Contractor, but they are to be anchored to the supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
- I. Provide an appropriate quantity of fire suppression systems as required by local jurisdiction code requirements.
- J. Double wall insulated construction at ends. S/S where exposed.
- K. Hoods and components to meet all NSF standards, NFPA 96, UL 710 and current IECC requirements.
- L. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsection E. Division 23 (Mechanical) for additional information.

L. HIGHLIGHTING

- A. Polish the following vertical surfaces to a No. 8 finish:
 - 1. Serving and display shelf turndowns.
 - 2. Conveyor and dish/tray deposit station turndowns/frame.
 - 3. Tray slide turndowns.

M. SHOP / FIELD JOINTS

- N. Field joints: The least number is used only when equipment size must be limited for building or interior space access.
- O. Stainless steel tops (including edges and splashes): Fully welded, ground, and polished to match adjacent surfaces.
- P. Vertical field joints of fixture backsplashes that are inaccessible from the back: terminate 1" above the horizontal coved corner. The remaining height of the field joint: hairline butt joint with offset draw-angle behind. All horizontal/vertical draw joints: located and noted on shop drawings.
- Q. Hairline butt joint: 1½" x 1½" x 1/8" steel angles welded to the back/underside of countertop/shelf. Offset angle beyond joining metal edge ½" (min.) to provide a flat backing surface for a joint with the angle of other joining metal edge, set for ½" space between vertical legs of angles. Bolt sections together with 5/16" machine bolts, lock washers, acorn head cap nuts, set 3" OC.
- R. Closed Base Bodies: Draw-type with hairline seam fully field-welded.
- S. Millwork: Plastic laminated joints shall be dowelled, glued, and draw-bolted with fasteners.
- T. Solid Polymer: Surfaces drawn tight, filled, sanded, and finished to match adjacent surfaces.

U. PREFABRICATED WALK-IN COLD STORAGE ASSEMBLIES

- A. Assembly to be installed by Factory Authorized Installers only.
- B. KEC to provide a 1-year walk-in assembly panel installation warranty. Panel installation warranty to cover labor and part replacement issues resulting from a failure to complete the following during installation:
 - 1. Walk-in assembly panels to be installed square, plumb, and level.
 - 2. To create a proper seal, ceiling panels must be installed flush and tight to wall panels with undamaged gasket material. Any signs of condensation at joints or assembly wall panels should be reported to FDP and addressed immediately. Caulk at panel seams will not be an acceptable solution.
 - 3. All cam-locks should be engaged and cam-lock covers in place.
 - 4. Any gaps under the floor angle (due to shimming) must be entirely sealed to the slab.
 - 5. All penetrations in the ceiling or wall panels should be insulated and sealed by appropriate trade contractors and verified by KEC, including but not limited to Light Fixtures, Refrigeration Lines, Sprinklers, Temperature Sensors, etc.
 - 6. Proper installation of the door systems should allow the door to self-close and seal around the perimeter of the door opening and at the floor threshold.
 - 7. Final operation of the IC/IC+ control, door heaters, and light switches should be confirmed upon completion of the electrical connections.
 - 8. The walk-in assembly panel installation warranty will cover service issues resulting from faulty installation.

- C. **KEC is responsible for overall install accuracy/quality and quality control of work performed regardless of installer or any field modifications due to building/construction conditions. KEC is to provide a Letter of Install Approval to Foodservice Design Professionals (FDP) upon completed installation, verifying that all items above have been inspected by the KEC for completeness and installed per manufacturer requirements. This letter will be required as part of the completion of the contract.**
- D. Sectional Assemblies: Size/shape indicated on drawings; 9'-6" interior clearance unless otherwise specified. Door locations/size: exactly as shown.
- E. Sandwich Panel Insulation: Class 1 Urethane with a vapor barrier, 4" thickness (unless specified otherwise) with mature "U" factor of .030 or lower. Finished panels shall be UL-listed and demonstrate a flame spread rating of 20 or less. Panels must meet performance standards as outlined in U.S. Government legislation.
- F. Wherever compartment dimension exceeds the clear-span ability of ceiling panels, provide I-beam support on the exterior of the ceiling or spline-hangers. Install 1/2" diameter steel rods through beams/hangers and secure them to the structure above. Beams or posts within compartments are not acceptable.
- G. Reinforce prefabricated wall panels to rigidly support the door assemblies. The perimeter of the door and frame shall be built of a fiberglass reinforced polymer (FRP) pultrusion. All pultrusion's shall be non-conductive, non-corrosive, rust proof and NSF listed. All doors shall be furnished with a replaceable aluminum braided heater wire, electronically monitored, and controlled as to initiation temperature, termination temperature and percentage of operation time as required. Install 2" x 4" 16-gauge stainless steel hat-channel full-width of the jamb with 1/8" stainless steel removable flush sill, secured with stainless steel screws and sealed watertight to channel.
- H. Reinforcement as required to be provided above Freezer door (exterior) and panel next to door (handle side – interior) for mounting of Emergency Strobe Beacon, Push Button Panic Alarm and Release Knob. Emergency Strobe Beacons are by Division 26.
- I. Provide an aluminum cove base at the interior and exterior of exposed panels for all floor assemblies.
- J. Floor Installations:
 - 1. **4" Recessed Exposed Factory Floor Installation (if required):**
 - a. 6 mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
 - b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
 - c. 4" commercial grade manufacturer's dura floor with diamond treadplate surface and marine grade plywood subfloor.
 - d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
 - e. 1/2" sand leveling bed by G.C.
 - 2. **8-1/2" Recessed Floor Installation (if required):**
 - a. Factory floor in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.

- b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
 - c. 4" manufacturer's floor.
 - d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
 - e. 1/2" sand leveling bed by G.C.
 - f. Concrete flooring and tile over insulation by Divisions 03/09.
3. **12" Recessed Floor Installation (if required):**
- a. 6 mil polyethylene sheets in slab recess with all joints lapped 6 inches and sealed to form a watertight seal.
 - b. Level and square prefabricated perimeter and partition wall panels anchored to slab recess. Protect the exposed surface of panels.
 - c. 4" manufacturer's floor.
 - d. 15# felt slip sheet over insulation with 6" lapped joints flashed up the height of the finished floor base.
 - e. 1/2" sand leveling bed by G.C.
 - f. Concrete flooring over insulation by Division 03:
 - i. Concrete mix: 5000 psi @ Freezers and 3000 psi @ Coolers.
 - ii. No limestone or fly ash; fiberglass reinforced.
 - iii. #3 rebar, set on 12" centers in both directions.
 - iv. Center rebar vertically in wearing bed.
 - v. 10" high concrete 45° angled wall curb at interior perimeter per food service details.
 - g. Diamond treadplate wall panels on the interior and exposed exterior by 11 40 00. Refer to drawings for height. Coordinate diamond treadplate wall covering at the interior with angled wall curb.
 - h. Ventilation Pipe Requirements by G.C.:
 - i. Bottom perforated vent pipes to be #40 PVC on six ft. max centers open on both ends with the thermostatically controlled fan on (1) end and perforated mesh on the opposite end of the fan at the exterior of the building.
 - ii. Vent pipes are to be turned parallel with the exterior wall - 180° turn down.
 - iii. Vent pipe openings to be held at 24" above grade or roof per design.
 - iv. Fans to be Grainger Manufacturer and sized per airflow needs. Airflow is to be sized based on the length and number of bends.

- v. If no exterior wall is adjacent, vent pipes will route up and extend past the roof. Roof penetrations by Division 07.

4. **Surface Mounted Factory Floor Installation (if required):**

- a. 4" commercial grade manufacturer's dura floor with diamond treadplate surface and marine grade plywood subfloor.
 - b. 36" reinforced diamond treadplate internal ramp.
 - c. 10-gauge stainless steel threshold to provide a smooth transition to the interior walk-in assembly floor.
- K. Modularm Model No. 75LC (Unless otherwise specified). Integrated, flush-mounted temperature monitor/alarm with sensor and probe-cord length required to extend from the exterior front of the assembly to a mounting position of the sensor within the evaporator return airstream. System to have an easy-to-read LCD with high and low alarm set points with audible and visual alerts for alarm conditions. System to include Adaptive Programming for automatic set point control. Wi-Fi connectivity is included for remote notifications of alarms such as power failure, high and low temperatures, entrapment, and door open. System to include a built-in panic alarm. The system is to be interconnected to the Building Automation System (BAS) or the Owner's Network (by Division 27) and to notify facility personnel of the district/owner choosing when activated.
- L. Modularm Model No. IP-1 (unless otherwise specified). Heated Illuminated Push Button Panic Alarm with protective cover and Phenolic Label "PANIC ALARM" for entrapment **within Freezer** (ADA mounting height). Panic Alarm Encasing is to be stainless steel (not plastic). Manufacturer to pre-run conduit within panel from Panic Alarm to panel above Freezer door (or Cooler door if 'inline' assembly) for installation of Emergency Strobe/Horn. Division 26 will provide (2) external Emergency Strobe/Horn Beacons and interconnect the Push Button Panic Alarm to external Beacons (One above the Freezer door and One in the Cafetorium in location as directed by Architect). Division 27 will interconnect the Push Button Panic Alarm to the Building Automation System for Owner notification. Refer to Section 1.4: OTHER DIVISIONS/CONTRACTORS RELATED WORK; Subsections F. Division 26 (**Electrical**) and G. Division 27 (**Communication**) for additional information.
- M. KE2 Smart Access (unless otherwise specified). Confirm all component model numbers for complete installation and operation.
- N. LED surface-mounted light fixture, in quantity/arrangement shown on drawings. Light fixtures to be perpendicular to coils. Light fixtures wired to interior and exterior temperature control panel. Light fixtures are to be provided by Section 11 40 00 and installed by Division 26. Division 26 is to seal all conduit penetrations at light fixtures. KEC to verify that penetrations are sealed.
- O. Penetrations of Panels: To be sealed by factory installer and appropriate trade contractors, with Dow Corning 3-6548 silicone RTV foam, total depth of the panel. Trim excess flush. KEC to verify that all penetrations are sealed.
- P. Install closure panels and trim strips to building walls and ceiling with concealed attachment. Closure material: same as wall panels unless noted otherwise.
- Q. Compartment Entrance Doors: 36" x 78" nominal clearance unless otherwise noted.
- 1. Mount hinged doors on two Kason Model No. 1346; polished chrome-plated nylon cam-lift hinges. All doors to be equipped with polished chrome Kason 1094 or equivalent door closer assembly. Doors to be adjusted so all doors fully self-close.

2. Hinge doors as indicated on drawings.
 3. Defrost heater: Thermostatically controlled and replaceable at the entire perimeter of all doors. Defrost heaters to be wired for continuous service.
 4. 36" high x full-length diamond aluminum treadplate at front and rear of all hinged doors.
 5. 12" x 2" engraved phenolic plastic compartment identification sign in Architect's color selection with 1" letters, mounted above door window.
 6. 14" x 24" four-panel glass view window with heater and molded non-metallic inner and outer frame. The heater is to be wired and controlled via the door monitor for continuous service.
 7. Padlock/key provisions in the door latch with safety release mechanisms.
 8. Kason 1826 Intelli-Vent LED Heated Pressure Relief Ports with Dual Port Vent and Security Light. Locate Two (2) 12" below ceiling on Cooler/Freezer common wall panel and Two (2) 12" below ceiling on Cooler wall panel. If Cooler and Freezer are separate units, locate one on the Freezer wall panel as well, 12" below ceiling and mounted in the door frame assembly. All ports to have separate dedicated electrical connections and be wired for continuous service. Located and installed by Manufacturer.
 9. Kason Model No. 1238CQ (unless specified otherwise) Pacesetter Locking Handle QTLC polished chrome with Kason 0485 glow-in-the-dark backplate and turn knob safety release.
 10. Manual backup vacuum release mechanism to punch 6" diameter hole in ceiling panel to release vacuum within freezer assembly. Mechanism to include a pull-down handle with freeze-proof hand grip. Handle to have the ability to penetrate and/or punch hole in wall accordingly to assist with opening of door assembly in the event of entrapment (and failure of inside release knob). Release mechanism assembly to be built-in/mounted to panel structural frame to minimize mechanism tear-out and/or failure. Handle to be glow-in-dark yellow with phenolic label "Vacuum Pressure Release." Punch out portion to be replaceable in opening without the use of tools or sealants. Punch out is not to be located directly over interior ramp.
 11. Provide Two (2) Edwards 860 Series (or equal) red lens, surface-mounted Xenon Emergency Strobe Beacons. Walk-in manufacturer will install One (1) located in the Kitchen above Walk-In Freezer door (or Cooler door when Freezer is within Cooler in an 'inline' assembly) and provide the second unit loose for installation by Division 26 located in the Cafetorium (Division 26 to coordinate location with Owners and Architect). Division 26 is to provide all conduit and wiring required and interconnect the illuminated Push Button Panic Alarm in the Walk-In Freezer to both Strobe Beacons (**Critical**).
- R. Provide refrigeration calculations and refrigeration alarm to meet local jurisdiction code requirements.
- S. If air screens or air shields are specified above doors or on the interior of the assembly, the manufacturer must provide adequate blocking in panels to support these components and pre-wired electrical connections. Installer to coordinate location of door closure to not interfere with air screens or air shields. Clear-VU, swinging door assemblies, are not required if air shields are specified.
- T. S/S trim above walk-in assembly to conceal manufacturer ceiling grid.

- U. Field-check all horizontal/vertical measurements and conditions at the building before fabrication or delivery of equipment.
- V. Walk-in Assemblies to be installed by the PRE-APPROVED INSTALLERS listed below:
 - 1. QBR Refrigeration, 30083 Hwy 90 Blvd., Katy, TX 77493, Mr. Andy Spellins, 713-973-2875, andy.spellins@qbrsales.com
 - 2. Machine Ice, 8915 Sweetwater Ln., Houston, TX 77037, Mr. Will Weaver, 281-448-7823
 - 3. Coolers Inc., 6922 Alder Dr., Houston, TX 77081, Mr. Lee Mamone, 713-665-8886

V. **WALK-IN COLD STORAGE ASSEMBLY REFRIGERATION SYSTEMS**

- A. Unit Coolers: specified quantity and model, ceiling-hung by ½" OD nylon bolts with stainless steel washers and nuts. Insert hanger bolts through the plastic sleeve and seal penetration airtight.
 - 1. Unit cooler drain fittings: positioned as indicated on drawings. Installation of cast tee-fittings on drain pan outlet with union and cleanout plug and extension of 1" Type K copper drain line through wall panel to airgap fitting or floor drain under this Section.
 - 2. Slope drain line ½" per foot, trap at the exterior of assembly and turn down into the drain. Manifold drain lines of adjacent compartments wherever possible.
 - 3. Install drain line plastic sleeve through compartment wall, seal around drain line, and install stainless steel escutcheon with setscrews.
 - 4. Electric drain line heater cable (self-regulating 7 watts): on all unit coolers operating below 36°F., installed from coil drain line fitting to wall penetration under this Section. Heater cables: the minimum rating of 15 watts/lineal foot, 208 volts, single phase. Wrap drain line with maximum 2" loop spacing and interwire to unit cooler for continuous operation.
 - 5. Mounted, pre-piped, and pre-wired evaporator components:
 - a. Sporlan thermostatic expansion valve with external equalizer.
 - b. Shut-off valve at evaporator suction and liquid lines.
 - c. Sporlan "Catch-All" refrigerant filter/dehydrator on liquid line.
 - d. White Rogers 1609-101 adjustable thermostat with remote bulb positioned in return airstream of the evaporator.
 - e. Electrical disconnect switch in NEMA 4 enclosure.
 - f. **For any facility within 20 miles of a salt air environment:** Condenser and Evaporators to be built with Electrofin coating to retard salt air deterioration. Coils are to be coated with Technicoat 10-2 coating for protection against a salt air environment.
 - g. 110° Ambient Temperature Operation.
 - 6. Two (2) fan door activation switches to turn off evaporator coils when the door is opened.
- B. Refrigerant System Installation:

1. Refrigerant Lines; Type "L" rigid copper tubing. Fittings: Wrought copper or brass designed for use with high-temperature solder. Piping joints: Made with silver solder (Sil-Fos). Piping: Properly suspended from and anchored to the structure with adjustable hangers 6' OC maximum. Suction lines: Sized to have a maximum pressure drop of two pounds in medium-temperature systems; one pound in low-temperature systems. Liquid lines: Sized to give maximum pressure to prevent trapping of oil. Insulation on all suction lines: Armaflex insulation by Armstrong. ¾" thick at medium-temp 1" thick at low temp. Refrigerant lines in PVC conduit: Sealed at both ends with Dow Corning 3-6548 silicone RTV foam. The refrigeration system installer will wrap Exterior Refrigerant Lines in the self-fastening jacket of Type 3003-H14 aluminum alloy 0.016-inch thick. Provide aluminum strapping and seals for applying aluminum jackets and covers according to the manufacturer's recommendations for a completely weather-tight covering.

C. Evacuation and Charging:

1. After completion of the pressure test, the system shall be evacuated using an approved auxiliary vacuum pump. Connections for evacuation: Following the manufacturer's recommendations.
2. Charging after the initial charge, which is contained in the condensing unit (R448A Non-CFC Ozone Depletion Refrigerant for medium and high temp units, R513A - Non-CFC Ozone Depletion Refrigerant on low temp units) – (Refrigerant must meet District Standards, Industry Standards, and local Codes): given through the charging valve in the high side passing all of the liquid refrigerants through a charging dehydrator. All charging lines and gauges must be purged of air before connection with the system. Refrigerant: unused and shall be delivered in clean containers. After the system is fully charged: start and place it in full operation.

D. Refrigeration system to be installed by the **PRE-APPROVED INSTALLERS** listed below:

1. QBR Refrigeration, Mr. Andy Spellins 30083 Hwy 90 Blvd., Katy, TX 77493, 713.973.2875, andy.spellins@qbrsales.com
2. Machine Ice, Mr. Will Weaver, 8915 Sweetwater Ln., Houston, TX 77037, 281.448.7823
3. Coolers Inc., 6922 Alder Dr, Houston, TX 77081, Mr. Lee Mamone, (713) 665-8886

W. PRE-APPROVED KITCHEN EQUIPMENT CONTRACTORS

- A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid.

B. Any contractor requesting inclusion within this bid must submit AIA form 305 a minimum of 14 days before the bid date for review or as required by Architect.

1. Stafford Smith, Mr. JP Garcia, 7129 North Loop East, Houston, TX 77028, Phone: 713.892.5001, Email: jpgarcia@staffordsmith.com
2. Texas Metal Equipment Company, Mr. Travis Andrews, 23518 Coons Road, Tomball, Texas 77375, Phone: 713.466.8722, Email: tandrews@tmeco.com
3. Kirby Restaurant Supply, Mr. Brian Kernan, 809 S. Eastman Road, Longview, Texas 75602, Phone: 903.757.2723, Email: briank@kirbysupply.com
4. Mission Restaurant Supply, Mr. Robert Snoddy, 1126 S. St. Mary's Street, San Antonio, Texas 78210, Phone: 832.970.4020, Email: roberts@missionrs.com

5. Kommercial Kitchens, Mr. Terry Woodard, 13544 East Fwy., Houston, TX 77015, Phone: 409.769.1199, Email: terry@kommercialkitchens.com
6. Supreme Fixtures Co., Inc., Mr. Tim Hampel, 11900 Vinny Ridge Road, P.O. Box 193655, Little Rock, AR 72219, Phone: 501.455.2552, Email: tim@supremefixture.com
7. Amundsen Commercial Kitchens, Mr. Lewis Beville, 105 Montie, Longview, TX 75604, Phone: 903.576.6354, E-mail: lewis@afeok.com

X. PRE-APPROVED STAINLESS-STEEL FABRICATION SUPPLIERS

- A. Only the following named Subcontractors and those approved later, if any, are approved for inclusion in the Contractor's Bid. Pre-approved fabricators shown below shall not sub-out fabrication.
- B. **Any supplier requesting inclusion within this bid must submit AIA form 305 at least 14 days before the bid date for review or as required by Architect.**
 1. Texas Metal Equipment Company, Mr. Travis Andrews, 23518 Coons Road, Tomball, Texas 77375, Phone: 713.466.8722, Email: tandrews@tmeco.com
 2. Kommercial Kitchens, Mr. Terry Woodard, 13544 East Fwy., Houston, TX 77015, Phone: 832.767.5287, Email: terry@kommercialkitchens.com
 3. Mission Restaurant Supply, Mr. Robert Snoddy, 1126 S. St. Mary's Street, San Antonio, Texas 78210, Phone: 832.970.4020, Email: roberts@missionrs.com
 4. CSS Manufacturing, Mr. Jared Woodard, 7430 Fairbanks North Houston Rd., Houston, Texas 77040, Phone: 832.444.6311, Email: jared.woodard@css-mfg.com

PART 3 - EXECUTION

3.1 DELIVERY AND INSTALLATION

- A. Supervision: Provide a skilled and proficient foreman or supervisor who shall remain on the job during the entire installation.
- B. Delivery: Coordinate with the progress of construction and Owner's operation schedules. Unless otherwise instructed and documented by Owner or General Contractor, the following procedures apply:
 1. Field-Assembled Fixed Equipment integrated into the structure (e.g., walk-in assemblies, exhaust hoods, drain trench/grate assemblies, conveyor systems, ceiling-mounted utensil racks, etc.) are to be sent to the job site when directed by the General Contractor and installed/protected accordingly.
 2. All other Fixed Equipment: delivered after completion of work on adjacent finished ceilings, lighting, finished floor and wall systems, including painting.
 3. Major Movable Equipment: delivered, when possible, to inventory in a secured area for interim job-site storage or, if the secured area is unavailable when fixed equipment installation/clean-up has been completed.
 4. Minor appliances and loose items (e.g., pans, covers, flatware containers, etc.) should be delivered only when the Owner is prepared to receive and inventory such items.

- C. Installation: performed by the manufacturer of custom fabricated fixtures.
1. Assemble, square, level, and ready all items for the final utility connections.
 2. Cut neatly around obstructions to provide sanitary conditions.
 3. Where gaps of $\frac{1}{4}$ " or less occur adjacent to or between equipment, insert rope backing and smoothly apply General Electric construction sealant Series SE-1200 silicone mastic (clear color). Mask both sides of the gap for neat sealant application and remove excess. If space exceeds $\frac{1}{4}$ ", neatly install 18-gauge stainless steel trim molding of proper shape with concealed attachment. Use epoxy cement or "Z" clips wherever possible to secure stainless steel trim. Exposed edges or corners of trim: eased and smooth.
 4. Refrigeration coil drain line runs to an indirect drain connection greater than 2" from the face of the wall or panel: Either of the following field procedures:
 - a. Trench the floor and provide a 6" wide x 2" deep 16-gauge stainless steel sloping (-1" to -2") trough from the face of the cooler/freezer wall to the body of the floor sink/floor drain. Trough: turned up 4" at the wall; $\frac{3}{4}$ " flange with $\frac{1}{2}$ " turndown at both long sides. Set trough in waterproof mastic and seal 1" OD drain tube penetration into floor sink/floor drain at -2 $\frac{1}{2}$ " BFF. Patch the floor to match adjacent material/surface.
 - b. Provide 12" x 6" x 2" deep 16-gauge stainless steel condensate pan mounted to cooler/freezer wall at 6" AFF clear. Trench the floor and install a 1" OD drain line from the bottom of the pan to the body of the floor sink/drain. Slope drain line $\frac{1}{4}$ " per foot and seal all connections watertight. Patch the floor to match adjacent material/surface.
- D. Protection of Work:
1. Fabricated fixtures: Fiberboard or plywood taped to tops and exposed body panels/components.
 2. Manufactured Equipment: Fiberboard or plywood taped as required by equipment shape and installation-access requirements.
 3. Prohibited use of equipment: Tool and materials storage, workbench, scaffold, stacking area, etc.
 4. Damaged Equipment: Immediately documented and submitted to the Owner with the Contractor's recommendation of action for repair or replacement and its impact on the Project Schedule and Contract Amount, if any.

3.2 CLEAN AND ADJUST

- A. Clean up and remove all debris from this Work from the job site as the installation progresses.
- B. Lubricate and adjust drawer slides, hinges, and casters.
- C. Adjust pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, exhaust hood grilles, etc.
- D. Clean or replace faucet aerators and line strainers.
- E. Touch-up damage to painted finishes.

- F. Start up and check the operation of all refrigeration systems for at least 72 hours before acceptance.

3.3 EQUIPMENT START-UP/DEMONSTRATION

- A. Carefully test, adjust, and regulate all equipment following the manufacturer's instructions and certify in writing to the Owner that the installation, adjustments, and performance are in full compliance.
- B. Provide the Owner or food service Operators with a thorough operational demonstration of all equipment and furnish instructions for general and specific care and maintenance. Coordinate and schedule selected equipment items and attendees with the Owner at least two weeks before the demonstration starts.

3.4 FINAL OBSERVATION

- A. Final observation will be made when the Contractor certifies that they have completed their work, thoroughly reviewed the installation/operation of each item in the contract and found it to comply with the Construction Documents.
- B. Repetitive final observations (more than two) and all costs associated with it which may be incurred due to the Contractor's failure to comply with the requirements of this Article will be invoiced to this Contractor on a \$70.00/hr and expense basis.

PART 4 - EQUIPMENT SCHEDULE

4.1 REGULARLY MANUFACTURED EQUIPMENT/COMPONENTS: Standard finishes and accessories unless specifically deleted or superseded by the Contract Documents.

4.2 FABRICATED AND FIELD-ASSEMBLED EQUIPMENT: Arrangement and configuration as shown on Plans, Elevations, Detail Drawings, and outlined in Specifications.

4.3 REFER TO DRAWINGS: For unit quantities and plumbing, electrical or mechanical provisions are required, including the manufacturer's optional voltages, wattages, burner capacities, etc.

4.4 REFER TO PART 2 – PRODUCTS: For accessories, fittings, requirements, and procedures related to the listed buy-out and fabricated equipment.

4.5 ALTERNATE MANUFACTURER REQUIREMENTS: A specific product manufactured by the listed pre-approved equals shown under Section 4.7 Food Service Equipment are acceptable only if the specific product can evidence compliance with the specified line items and the contract documents (Refer to Section 1.6; Sub-Section A.).

4.6 RE-USED EXISTING EQUIPMENT IF PROVIDED IN THIS PROJECT

- A. Existing equipment scheduled for re-use is to be inventoried and documented that equipment is in operating condition once Kitchen Contractor has taken ownership.
- B. Provide pictures of all equipment once inventoried and issue them to the architect to ensure that equipment has not been damaged.
- C. Verify the locations of all equipment with the owner.
- D. Existing equipment that is to be reused may need parts or accessories for proper and complete operation. Submit a report listing all items with pricing for approval to allow complete installation.

- E. Utility disconnection and re-connection: Under Divisions 22 and 26. Kitchen Contractor to verify utility requirements of existing equipment and coordinate with Foodservice Design Professionals (FDP) as required. If utilities shown on FDP drawings do not match the requirements of existing equipment – KEC is to relay that to FDP immediately. All utilities not scheduled for re-use must be capped and covered by required disciplines.
- F. Disassembly, removal, transportation, and relocation: under this Section and scheduled with General Contractor. The owner's representative must be present and coordinate the date/time with the owner.
- G. Thoroughly clean inside and out before relocation.
- H. Review functional parts (e.g., doors, controls, heating elements, compressors, etc.) and submit a report of required repairs and cost estimates. Any finishes or equipment damaged due to construction will be repaired as required.
- I. Existing equipment not scheduled for reuse is to be carefully removed/relocated by the Kitchen Contractor per the Owner's direction. Kitchen Contractor to coordinate the date/time with General Contractor and Owner.
- J. Removal or replacement of existing equipment is to be scheduled for times of least interruption and inconvenience to the food service operation. Submit the proposed time frame schedule, task sequence, and process for approval before starting work.
- K. Kitchen Contractor to verify size and shape for all existing re-used equipment and coordinate with Foodservice Design Professionals (FDP) as required.
- L. Any modification(s) required/desired for re-used existing equipment to be verified by the Kitchen Contractor. Before the changes are made, all modifications must be approved by the Owner and Foodservice Design Professionals (FDP).
- M. The KEC is to verify and coordinate all the utility requirements with the construction documents as required. Refer to the general specifications regarding conflicts.

4.7 FOOD SERVICE EQUIPMENT

- A. All equipment is to have a performance check from factory-authorized personnel. Warranties will begin on the day of the performance check.
- B. All equipment and internal components should be of domestic origin where possible.
- C. Architect to verify/coordinate the aesthetic options below (Food Service color, material, or signage selections) if these items are provided in this project:
 - 1. Countertops: Stone (stainless steel is provided unless otherwise specified)
 - 2. Tray slides: Corian or Stone (stainless steel is provided unless otherwise specified)
 - 3. Counter fronts: Ceramic tile, 3 Form, or Plastic Laminate
 - 4. Sneeze Guards: Stone insets
 - 5. General color, material and graphic selections:
 - a. Display Air Screen Merchandisers – Color selection: Powder Coat or Plastic Laminate (stainless steel is provided unless otherwise specified)

- b. Bakery Display Cases – Color selection: Powder Coat or Plastic Laminate (stainless steel is provided unless otherwise specified)
- c. Pass Thru or Reach-In Holding Cabinets - Color selection: Powder Coat (Mfg.: True) or Plastic Laminate (Mfg.: Traulsen) (Stainless steel is provided unless otherwise specified)
- d. Hanging Heat Lamps – Track and Fixture color selection
- e. Heated Merchandisers
- f. Portable Guide Rails – Stanchion and Belt color selection
- g. Popcorn machine – Signage selection
- h. Bottle Cooler – Signage selection
- i. Graphics Package information
- j. Hot Food Well covers

D. Architect to verify/coordinate the finishes below:

- 1. Walls: Ceramic Tile, Flat FRP, or Molded FRP (Smooth, Impervious, and easily cleanable as approved by local jurisdiction)
- 2. Ceilings: Removable Vinyl Face Tile (Smooth, impervious, and easily cleanable as approved by local jurisdiction)
- 3. Floors: Tile, Epoxy, or Rubberized flooring system (Smooth, impervious, easily cleanable and slip resistant as approved by local jurisdiction) (Coordinate floor tile transition at serving lines)
- 4. Floors: Walk-in Assembly – Extend kitchen floor flush into Walk-in assembly with coved base
- 5. Furr Downs above Serving Counters

CULINARY

ITEM NO. 102 COLD STORAGE ASSEMBLY

QUANTITY 1

Manufacturer: ThermoKool
Model: ---
Size and Shape: Refer to drawings
Alternate: American Panel, Kolpak

1. **Installation to be completed by Factory Approved / Authorized installer. Refer to Section 2.33 Submittal drawings to include factory approval letter or certificate.**
2. Manufacturer to review final installation and provide a letter confirming installation meets manufacturer requirements.
3. Assembly to have 9'-6" interior clearance.
4. 304 #3 finish 20 gauge stainless steel finish where exposed, 26 gauge Acrylume where concealed.
5. Factory floor with smooth aluminum finish, recessed in slab 8 1/2". Secure floor to wall assembly with cam-lock assembly. KEC to ensure the floor assembly is level prior to the wearing bed installation. Kitchens finished floor to extend to walk-in.
6. Threshold to be smooth and level with finished floor. - Critical.
7. Interior walls to be .040" aluminum, white embossed texture on walls.
8. Ceiling to be embossed textured .040" aluminum baked white enamel.
9. Two (2) 36" doors. Doors to be 18-gauge stainless steel, type 304 (18-8), #3 finish, with heated perimeter / door jambs / windows and threshold heaters. Each door to be equipped with 3'-0" high diamond tread kick plate on both sides of doors. Mount hinged doors on two (2) Kason model no. 1346 (or equal); polished chrome plated nylon cam-lift hinges. Proper installation of the door systems should allow for the door to self-close and seal around the perimeter of the door opening and at the floor threshold.
10. Provide heated illuminated Push Button Panic Alarm with protective cover and Phenolic Label "PANIC ALARM" for entrapment within Freezer (ADA mounting height). Panic Alarm Encasing is to be stainless steel (not plastic). Manufacturer to pre-run conduit within panel from Panic Alarm to panel above Freezer door (or Cooler door if 'inline' assembly) for installation of Emergency Strobe/Horn. Division 26 will provide (2) external Emergency Strobe/Horn Beacons and interconnect the Push Button Panic Alarm to external Beacons (One above the Freezer door and One in the Cafetorium). Division 27 will interconnect the Push Button Panic Alarm to the Building Automation System for Owner notification.
11. Reinforcement as required to be provided above Freezer door (exterior) and panel next to door (handle side - interior) for mounting of Emergency Strobe Beacon, Push Button Panic Alarm and Release Knob.
12. The Cooler will have the standard control panel with standard panic button tied into the Owner's network for notification.
13. Provide Kason model no. 0487 Frost Free Inside release (or equal) for each cold storage door assembly. Fiberglass rod and plastic flange, with safety glow plastic knob, ADA compliant.
14. Manual backup vacuum release mechanism to punch hole in wall assembly to release vacuum within freezer assembly. Mechanism to include a pull-down handle with freeze-proof hand grip. Handle to have the ability to penetrate and/or punch hole in wall accordingly to assist with opening of door assembly in the event of entrapment (and failure of Frost free inside release button). Wall panel to include a knockout section to assist with requirements. Release mechanism assembly to be built-in/mounted to the door assembly structural frame to minimize mechanism

- tear-out and/or failure. Handle to be painted yellow with phenolic label "Vacuum Pressure Release".
15. 20-gauge stainless steel, type 304 (18-8), #3 finish trim where adjacent to walls and enclosure panels that extend to 2" above finished ceiling.
 16. Freezer One (1) lot LED light fixtures to operate in temperatures to -20 F. Lights to be installed perpendicular to coils.
 17. Refrigerator- One (1) lot LED light fixtures. Lights to be installed perpendicular to coils.
 18. 3'-0" high diamond tread plate at exposed exterior surfaces. Fasten to wall with stainless steel fasteners.
 19. Provide door bumper at doors.
 20. Compartments to have all electrical concealed within the walls or located above the ceiling.
 21. Provide Manufacturers alarm/control system that includes hi/low limits. Route temperature sensor to be located to the side of evaporator coil.
 22. Doors to be provided with CCI Industries, Inc., Clear-VU swinging door assemblies, Alternate: Kason. (
 23. All holes in assembly to be sealed by factory installer.
 24. KEC to field verify all horizontal/vertical measurements and conditions at the building prior to fabrication or delivery of equipment.
 25. KEC to provide 1-year walk-in panel installation warranty. KEC is responsible for overall install accuracy/quality and quality control of work performed regardless of installer or any field modifications due to building/construction conditions. KEC to provide Letter of Install Approval to FDP upon completed install.
 26. Manufacturer to provide One Year Parts and Labor Warranty.
 27. Interwiring of temperature monitor panel to master building alarm system or to the Owner's network. Technology department to provide all interfacing of alarm system and with the building alarm system. Conduit from refrigeration system to monitor by Division 26. Temperature Monitor installation at 4'-0" above finished floor. All conduit to be located above walk-in cooler/freezer ceiling. Exposed electrical conduit is not acceptable.
 28. Manufacturer Representative to provide training on controls and inside emergency release mechanisms.

ITEM NO. 103

REFRIGERATION SYSTEM-STANDARD

QUANTITY 1

Manufacturer: RDT
Model: ZS1-2 EcoSmart
Size and Shape: Refer to drawings
Alternate:

1. Air cooled system.
2. Scroll Compressors.
3. Cooler temperature to be +35 degrees.
4. Freezer temperature to be -10 degrees.
5. EcoSmart system on demand defrost.
6. KE2 Evap Controllers located per Owner requirements.
7. S/S covered housing.
8. A dedicated electrical connection to be provided for heated condensate drain line. Refer to electrical plan for location.
9. All exterior piping to be aluminum wrapped.
10. System to accommodate Item No. 102 Cold Storage Assembly.

FOOD SERVICE EQUIPMENT

11 40 00 - 50

11. S/S covered housing mounted to a 24" tall 1/8 galvanized angle iron frame anchored to concrete pad. Provide S/S skirting around frame.
12. Mount condensing unit on common exterior rack. Refer to Architectural and Engineering drawings for exact location of remote unit. Coordinate routing of refrigeration lines and conduit with appropriate trades. Heat tape and insulate all drain lines. General Contractor to seal all building penetrations at refrigeration lines.
13. Provide two (2) year parts and labor warranty for all parts and components (including third-party components that may be utilized).

ITEM NO. 104 COLD STORAGE SHELVING

QUANTITY 2

Manufacturer: Metro
Model: Metro Max Q
Size and Shape: Refer to drawings
Alternate:

1. Each unit to be four (4) tiers high with open grid mats.
2. Four (4) 74" post per unit. Provide foot plates at all posts when assembly is supplied with walk-in floor.
3. Refer to drawings for size, width and lengths.
4. Quantity Two (2) to equal One (1) lot: all shelving shown within cold storage assembly.
5. Verify shelving requirements with approved submittal prior to ordering.

ITEM NO. 107 DRY STORAGE SHELVING

QUANTITY 1

Manufacturer: Metro
Model: MetroMax Q
Size and Shape: Refer to drawings
Alternate:

1. Each unit to be five (5) tiers high with open grid shelving.
2. Four (4) 86" posts per unit.
3. Quantity One (1) to equal One (1) Lot: all shelving shown within the dry storage room.
4. Refer to drawings for size, width and lengths.
5. Verify shelving requirements with approved submittal prior to ordering.

ITEM NO. 109 ICE MAKER WITH BIN - 500 LB CAPACITY

QUANTITY 1

Manufacturer: Manitowoc
Model: IYT-0450A/D570
Size and Shape: Refer to drawings
Alternate: Scotsman

1. Energy Star Rated.
2. Stainless steel bin.
3. Stainless steel legs.
4. Provide bin adapter kit as required.

5. Easy Touch Controls, set filter reminders, get error messages/faults, program run/stop times, display serial/model information, view step-by-step cleaning/sanitizing prompts, view warranty expiration timer.
6. Provide Luminice II Virus and Bacteria Inhibitor.
7. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to Ice Machine.
8. Cord and plug assembly, coordinate NEMA configuration with electrician.
9. One (1) pre-filter and water filter sized to manufactures recommendations. Provide two (2) sets of replacement filters. Mount on wall adjacent to ice machine in an easily accessible location.
10. Coordinate cord and cap with receptacle. Water supply to filter to be hard copper plumbed. 72" long flex hose from filter to ice maker with 48" wall restraint cable. Interconnection thru water filter to ice machine and final connection by Division 22. Water filter overflow tube to be strapped to back side of ice machine and extend to 1" above floor sink.

ITEM NO. 111 CHEMICAL SHELF

QUANTITY 1

Manufacturer: Metro
Model: MetroMax Q
Size and Shape: Refer to drawings
Alternate:

1. Each unit to be four (4) tiers high with open grid mats.
2. Four (4) 74" posts per unit.

ITEM NO. 122 TWO COMPARTMENT SINK WITHOUT DISPOSER

QUANTITY 4

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S marine edge with 2" turndown at free sides.
2. Open base construction.
3. Two (2) 24" x 26" x 15" deep sink compartments.
4. 10" high splash where adjacent to walls/fixtures.
5. Provide One (1) BIGFLO B-0287-BC pre-rinse W/Add-A-Faucet, **two (2) B-0109-04 18" wall bracket (dealer cut to correct length)**, one (1) additional spray face model no. 108SFRK with ceramic cartridges.
6. Two (2) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. 12" deep single post mounted perforated overshell at 18" above counter top.
8. **18 gauge butt joint wall panel from splash to underside of shelf.**
9. 12" deep single post mounted perforated overshell at 18" above counter top, punched to accommodate spray rinse.
10. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x 1/4" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with owner.
11. Provide top and bottom c-channel support storage for sink covers at right or left end of counter.
12. One (1) Edlund model no. S-11 Manual can opener, mounted on raised platform.
13. Flanged feet at front only.

14. Seal at all splash penetrations.

ITEM NO. 123 DISPOSER-CONE MOUNT

QUANTITY 1

Manufacturer: Salvajor
Model: 200-CA-18-ARSS -LD
Size and Shape: Refer to drawings
Alternate: In-Sink-Erator

1. Fixed nozzle.
2. Delete standard syphon breakers and provide T & S B-0456-04 vacuum breakers and mount 6" from tabletop to base of breaker.
3. Solenoid valve.
4. Flow control.
5. Model no. ARSS-LD control panel.
6. Auto-reverse.
7. Dejamming tool.
8. Install vacuum breaker in splash
9. S/S cone cover.
10. Perforated silver saver and disposer cone with scrap ring.
11. Two (2) Swirl inlet located in disposer cone at a 45 degree angle.
12. GC to pipe 1/2" cold water to disposer body and swirl inlets. Excess electrical cord to be secured to fabrication as required. Install into counter by section 114000.

ITEM NO. 124 WORKTABLE W. OVERSHELF

QUANTITY 8

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S top with 10" high backsplash at wall and 2" turndown at free sides.
2. Open base construction.
3. 16 gauge S/S oversheff post mounted 18" above working surface.
4. 16 gauge S/S undersheff.
5. Two (2) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S81-2020C drawer pan.
6. Close back of splash when exposed.

ITEM NO. 134 40 QUART MIXER

QUANTITY 1

Manufacturer: Hobart
Model: HL400
Size and Shape: Refer to drawings
Alternate: ---

1. Mixer, floor model, 40 qt. Capacity.
2. 208/60/1 cord and cap assembly by KEC.
3. 15 Minute timer, thermal overload, with magnetic starter

4. Epoxy enamel finish-floor model.
5. Stainless steel 40 & 30 qt bowl.
6. Aluminum "B" flat beater 40 & 30 qt.
7. Stainless steel "D" wire whip 40 & 30 qt.
8. One (1) "ED" dough hook 40 & 30 qt.
9. Bowl Scraper D340.
10. Aluminum Bowl truck.
11. One (1) CHUTE-D34 D340 40 & 30 qt, bowl guard with ingredient chute.
12. One (1) Year Extended warranty - parts and labor.
13. Coordinate cord and cap assembly with receptacle. KEC to provide cord and plug assembly to Division 26 for installation.

ITEM NO. 136 BAKER'S TABLE

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S with 2" square turn down at front, 6" high enclosed splash at sides and rear.
2. Provide finished back at exposed backsplash.
3. 12" deep post mounted overself at 18" above counter top.
4. Post mounted utensil rack, extend 1-5/8" diameter S/S post from back splash, turn forward 12" and weld full length x 2" x 1/4" S/S bar with Component Hardware model no. V-77-4401 S/S sliding hooks at 8" on center. Verify height with owner.
5. 18 gauge butt joint wall panel from splash to underside of shelf.
6. 16 gauge S/S flour trough.
7. Rear rail only.
8. One (1) lot Rubbermaid no. FG360288WHT ingredient bins.

ITEM NO. 138 PAN RACK

QUANTITY 2

Manufacturer: CresCor
Model: 207-UA-13A
Size and Shape: Refer to drawings
Alternate: Lakeside

1. Four (4) 5" casters.
2. Adjustable universal slides on 1-1/2" centers.
3. Corner bumpers.

ITEM NO. 139 INSUL. MOBILE PROOFER

QUANTITY 2

Manufacturer: CresCor
Model: H-137-WSUA-12D
Size and Shape: Refer to drawings
Alternate: Metro, FWE

1. Insulated proofer/heated cabinet.
2. Field reversible doors.
3. Adjustable universal angles.
4. Four (4) 5" casters, two (2) with brakes.
5. Tempered glass door windows.
6. Key lock handle.
7. Corner bumpers.
8. Cord and plug. Coordinate NEMA configuration with Electrician.
9. Thermometer.
10. 1500 watt heater.

ITEM NO. 151

FIRE PROTECTION SYSTEM

QUANTITY 2

Manufacturer: Ansul
Model: R102
Size and Shape: Refer to drawings
Alternate: ---

1. Duct and plenum protection to exhaust hood.
2. Surface protection for cooking equipment.
3. Locate remote fire pulls as recommended by Fire Marshal.
4. One (1) lot Mechanical gas valve (maximum diameter as required). Size as required. Furnished by Section 114000, installed by Division 22. Kitchen Equipment Contractor to coordinate location with local Fire Marshal requirements prior to submittal review. All conduits to be recessed within wall, SURFACE MOUNTING WILL NOT BE ACCEPTED.
5. System to meet U.L. 300 requirements.
6. Provide one (1) hand held Type 'K' and ABC 6 liter fire extinguisher per Ansul System, surface wall mounted. Verify mounting locations as required.
7. Exposed pipe threads are unacceptable.
8. All exposed piping to be chrome plated.
9. All hood penetrations to have U.L. listed "Quick Seal". Provide s/s escutcheons at all hood penetrations.
10. Provide phenolic I.D. labels for exhaust hood, remote fire pull, light/fan switches and fire protection system.
11. Provide a manufacturer performance test and report that verifies this system is fully operational.
12. Provide s/s cabinet as shown on plan.
13. Installer to provide one (1) Ansul system per exhaust hood, review drawings and provide systems as required.
14. Install hand held extinguishers, maximum of 3'-2" A.F.F. to top of unit.

ITEM NO. 152

EXHAUST HOOD

QUANTITY 1

Manufacturer: Mod-U-Serve
Model: W-CPB
Size and Shape: Refer to drawings
Alternate: ---

1. Size and shape as per plan.

2. Supply Air. Ceiling mounted supply plenum (with light fixtures), coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required.
3. Provide adjustable dampers that are easily accessible. Coordinate supply air, outside or tempered air(W-CPB) with engineer. Insulated make-up air plenum with 1" thick foil faced fiberglass insulation. Locate supply plenum in ceiling, coordinate location with GC as required.
4. U.L. Listed and fire rated 48" recessed LED lights located within the hood canopy. To meet minimum requirements of 50' candles of illumination.
5. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
6. Hood to meet requirements of ALL current local Mechanical and local Energy Codes.
7. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.
8. All 18 gauge S/S construction. S/S finish where exposed.
9. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
10. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
11. S/S filters and grease cup. Provide filter removal tool.
12. ½" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
13. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
14. S/S c-channel closure panel from top of hood to ceiling.
15. S/S filler panel between hoods if back-to-back.
16. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
17. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
18. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.
19. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.
20. Provide minimum 18-gauge stainless steel insulated wall panel 5/8" pan formed, filled with USDA Approved insulation. Extend from top of cove base to underside of hood.
21. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
22. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.

23. **Special Instruction:** Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 153

EXHAUST HOOD

QUANTITY 1

Manufacturer:	Mod-U-Serve
Model:	W
Size and Shape:	Refer to drawings
Alternate:	---

1. Size and shape as per plan.
2. Supply Air. Ceiling mounted supply plenum with light fixtures, coordinate conditioned/tempered air with engineer. Locate supply plenum in ceiling, coordinate location with GC as required.
3. Exhaust only canopy (W).
4. U.L. Listed and fire rated 48" recessed LED lights located within the hood canopy. To meet minimum requirements of 50' candles of illumination.
5. Simple on/off switches for hood fans and lights to be provided by Division 26. Control panels will not be accepted.
6. Hood to meet requirements of ALL current local Mechanical and local Energy Codes.
7. Collars to be field installed. Coordinate with existing conditions and install as approved by Hood manufacturer.
8. All 18 gauge S/S construction. S/S finish where exposed.
9. For extended cooking line-ups provide Continuous Capture canopies without partitions between hoods.
10. Hood to have insulated front face and ends to allow for ceiling grid attachment where ceiling grid meets hood capture area.
11. S/S filters and grease cup. Provide filter removal tool.
12. 1/2" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
13. All hood penetration to be fire rated and U.L. Listed and sealed with s/s escutcheons.
14. S/S c-channel closure panel from top of hood to ceiling.
15. S/S filler panel between hoods if back-to-back.
16. 4" air space at rear of hood. Provide S/S finished back where rear air space would otherwise be exposed.
17. Ductwork and final connection to hood above ceiling to be by the Mechanical Contractor.
18. Clearance requirement: Where any exterior surface of a hood is installed less than 18" from a combustible or semi-combustible surface, provide a minimum of 4" air space containing a code approved fire resistant material to that surface in a manner as prescribed by the manufacturer of that fire-resistant material. Protective materials provided by 3M Fire Barrier Duct Wrap 615+ and Fry Ware Elite are compliant with state and local mechanical codes. In addition, both systems meet the requirements of the testing standards of ASTM E2336 AND ARE THEREFORE APPROVED TO BE USED IN CLEARANCE REDUCTION APPLICATIONS.
19. Provide Mod-U-Serve model number ASTS-90 pre-set temperature sensor for automatic start of exhaust fan when the condition exists where the exhaust fan is not initiated at the wall switch and the temperature in the exhaust canopy reaches 110 degrees F. At the end of the cooking day when the fan is disengaged at the wall switch the thermostat (temperature sensor) will keep the exhaust fan on until the temperature in the exhaust canopy drops below 110 degrees F.

20. Provide minimum 18-gauge stainless steel insulated wall panel 5/8" pan formed, filled with USDA Approved insulation. Extend from top of cove base to underside of hood.
21. Refer to individual hood lengths as shown on drawings for each assembly required. Install at 6'-10" A.F.F. to bottom of hood, coordinate duct and fan requirements with Mechanical Contractor. Interconnect to wall mounted light switch by Division 26. Bulbs for light fixtures to be furnished and installed by Kitchen Equipment Contractor.
22. Mechanical contractor to test and balance exhaust hoods. Balance report to be provided to FDP upon completion.
23. **Special Instruction:** Refer to individual hood and plenum box lengths as shown on drawings for each assembly required. Install bottom of hood at 6'-10" A.F.F. Install plenum boxes recessed and interconnect to wall mounted light switch by Division 26.

ITEM NO. 159

CONDENSATE HOOD

QUANTITY 1

Manufacturer: Mod-U-Serve
Model: CH
Size and Shape: Refer to drawings
Alternate: ---

1. Refer to drawings for size and location.
2. Ventilator shall be manufactured with a full perimeter gutter with drain extended to floor sink. General Contractor to extend drain to floor sink.
3. Stainless steel enclosures to ceiling at all open sides.
4. Coordinate dish machine doors with condensate hood.
5. Entire system to be in compliance with NFPA pamphlet #96 and local governing code authorities, and shall be in accordance with Division 23. Shall be U.L. listed.
6. Manufacturer to check out system after installation to verify actual exhaust and supply air quantities and certify that performance is as designed and provide written report.
7. 1/2" diameter steel hanger rods at 4'-0" O.C. maximum to be by Kitchen Equipment Supplier, but they are to be anchored to supporting structure (or slab) by the General Contractor in the locations required by exhaust hood shop detail.
8. Start up and performance check to be provided by Manufacturer Service Agency. Manufacturer warranty to start on this date.
9. DIV. 22 to extend drain line from hood to nearest floor sink.

ITEM NO. 161

CONVECTION OVEN- GAS DBL

QUANTITY 2

Manufacturer: Blodgett
Model: DFG-200 DBL
Size and Shape: Refer to drawings
Alternate: Vulcan

1. S/S front, top and sides.
2. Two (2) 1/2 HP 2-speed motors.
3. Natural gas.
4. SSI-M solid state infinite control with manual timer.
5. Electronic spark ignition.
6. Five (5) oven racks per compartment.
7. Dual pane thermal windows.

8. Simultaneous door operation.
9. Heavy duty casters, two (2) with brakes.
10. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48" Gas Conn. Kit, 48" long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
11. Dedicated gas connections, do not manifold.
12. Shunt trip breaker by Division 26.
13. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.

ITEM NO. 167 MOBILE WORKTABLE

QUANTITY 6

Manufacturer: Aero
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S with 2" turndown at all sides.
2. Open base construction.
3. 16 gauge S/S undershelf per drawings.
4. Two (2) 20" W x 20" L drawer assemblies. Component Hardware #S52-2020 drawer slides with delrin bearings - 200lb capacity. Component Hardware #S81-2020C drawer pan.
5. 5" N.S.F. approved non-marking swivel casters, two with brakes.
6. One (1) ADA compliant table per classroom.

ITEM NO. 167B MOBILE WORKTABLE

QUANTITY 6

Manufacturer: Aero
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S with 2" turndown at all sides.
2. Open base construction.
3. 5" N.S.F. approved non-marking swivel casters, two with brakes.
4. One (1) ADA compliant table per classroom.

ITEM NO. 168 SS WALL CAP

QUANTITY 7

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. 2" square turndown at free ends.
2. Caulk and seal at wall with clear silicone.

3. Eased edges at exposed corners.
4. Coved turn up at full height wall, extended to ceiling.
5. Locate per drawings.

ITEM NO. 172

COMBI OVEN - GAS DBL

QUANTITY 1

Manufacturer:	Rational
Model:	ICP 6-FULL/6-FULL N/G
Size and Shape:	Refer to drawings
Alternate:	--

1. Pre-Installation Site Consultation, to verify building utilities and access are in place for the units ordered prior to units being installed on site.
2. 208/240V 1PH
3. Doors hinged on right.
4. Six (6) 18" x 26" or twelve (12) 12" x 20" pan capacity, per unit.
5. Standard warranty: 2 year parts and labor, installation inspection/start up.
6. Doors hinged per drawings.
7. Combi-Duo Stacking Kit, mobile.
8. Cleaner Tablets
9. Care Tablets.
10. **AutoDose option, with Cartridge chemicals.**
11. Gastronorm Grid Shelf, qty. 3.
12. Fry baskets, qty. 3 per oven.
13. Four hour chef training.
14. Heat shield.
15. Installation Kit "10", per unit, article number 8720.1560US.
16. Rational offers Certified Installation of units by Commercial Kitchens.
17. System installation to be reviewed by an authorized factory installer, provide report confirming installation meets factory's requirements.
18. Provide sizes and quantities as required: Dormont s/s water disconnect from filter to Combi Oven,color coded for filtered and non-filtered water.
19. KEC to coordinate filtered and unfiltered water with Combi Oven, do not connect filtered water to unfiltered water connection.
20. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48" Gas Conn. Kit, 48" long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
21. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.
22. Water supply to have shut-off valve and back flow preventer furnished and installed by Division 22. Supply water to interconnect thru water filter and then to each oven. Indirect drain line to be ran outside of the footprint of the unit, coordinate location of the related floor sink.

ITEM NO. 249 THREE COMPARTMENT SINK WITHOUT DISPOSER

QUANTITY 1

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14-gauge S/S 3" high 1-1/2" rolled rim at free sides, 10" high splash at walls.
2. Open base construction.
3. Omit rear rail at sink.
4. Three (3) 24" x 26" x 15" deep sink compartment.
5. Two (2) T&S model no. B-0291, splash mount faucet, 18" swing nozzle, LL inlets, for 3/4" hot and cold water connections.
6. Three (3) Fisher 22306 twist waste valve 3 1/2" x 2" with overflow and tailpiece. Provide 18 gauge S/S bracket for drain handle welded to sink bottom.
7. One (1) Chicago model no. 305-VBRCF hose bibb and rack mounted on 12 gauge S/S bracket ground and polished to match top. Hose and spray rinse by owner.
8. Omit front rail at hose bibb.
9. 16-gauge S/S undershelf as per drawings.
10. Flanged feet at front only of counter.
11. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.

ITEM NO. 251 DOOR TYPE DISHWASHER W. BOOSTER- TALL

QUANTITY 1

Manufacturer: Hobart
Model: AM16-BAS Tall
Size and Shape: Refer to drawings
Alternate: Champion

1. Dual purpose dishwasher, dish/utensils, door type, tall hood, straight-thru design, S/S construction.
2. Electric tank heat.
3. Electric booster heater.
4. Single Point electrical connection, including Motors, Controls and Tank Heat, and internal booster heater.
5. Pressure regulator valve.
6. One (1) Year Extended warranty - parts and labor.
7. One (1) Year Extended warranty on booster heater - parts and labor.
8. One (1) vent fan control.
9. Drain water tempering kit. Drain Water Tempering kit to be installed by Hobart Service.
10. Three (3) 20" x 20" Peg racks.
11. Three (3) 20" x 20" sheet pan racks.
12. Two (2) 20" x 20" combination racks.
13. Division 22 to provide and install backflow preventor between booster heater and filter. Final connection by Division 22. Coordinate location of electrical disconnects on free wall.
14. Provide Scaltrol Filter model #HSC-100 for Booster Heater. System to be located in an accessible location.

ITEM NO. 254 SOILED & CLEAN DISHTABLE

QUANTITY 2

Manufacturer: Custom Fabricated
Model: ---
Size and Shape: Refer to drawings
Alternate: ---

1. Top: 14 gauge type 304 S/S 3" high 1-1/2" rolled rim at free sides. 10" high splash at walls.
2. Install Disposer as shown. Notch and punch splash turn back for vacuum breaker. 12 gauge S/S bracket mounted below counter top and polished to match top for disposer control panel.
3. Provide One (1) T&S model no. B-0133-EE pre-rinse, B-0108-C spray head, two (2) B-0109-04 18" long wall bracket (dealer to cut to correct length), one (1) additional spray face model no. 108SFRK with ceramic cartridges.
4. One (1) 18" disposer cone.
5. Provide 1/2" slope in top towards dishmachine per the general specifications.
6. Anchor flanged feet to floor with non-corrosive bolts. Secure wall mounted equipment / components to in wall grounds or anchor plates. Coordinate installation with the general contractor.
7. Integrally welded with item No. 249.

ITEM NO. 255 MOBILE DRYING RACK

QUANTITY 3

Manufacturer: Metro
Model: PR48VX3
Size and Shape: Refer to drawings
Alternate: ---

1. Four (4) tier, includes two (2) drop-ins and (1) cutting board/tray drying rack, built in Microban antimicrobial product protection.
2. Two (2) no. 5MPX casters per unit.
3. Two (2) no. 5MPBX locking casters per unit.

ITEM NO. 260 HAND SINK - WALL MTD

QUANTITY 7

Manufacturer: Advance Tabco
Model: 7-PS-50
Size and Shape: Refer to drawings
Alternate: ---

1. 20 gauge stainless steel construction.
2. Basket drain and wall bracket.
3. Gooseneck faucet with wrist handles.
4. Soap and towel dispensers by Owner.
5. P-Trap assembly, delete open/close drain vavle.
6. Custom fabricated removable end splashes on sides as required by code. Height same as rear splash.
7. Trade contractor to provide temperature adjustment valves as required.

ITEM NO. 622 GRIDDLE

QUANTITY 1

Manufacturer: Vulcan
Model: 948RX-30
Size and Shape: Refer to drawings
Alternate:

1. Size and shape per plan.
2. S/S stand with Marine edges and casters, two (2) with brakes.
3. Stainless steel construction.
4. Electric spark ignition.
5. 3-1/2" wide stainless steel grease trough drain.
6. 3/4" rear gas connection and gas pressure regulator.
7. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48" Gas Conn. Kit, 48" long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
8. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.

ITEM NO. 632 SIX BURNER RANGE - GAS

QUANTITY 2

Manufacturer: Vulcan
Model: 36C-6BN
Size and Shape: Refer to drawings
Alternate: ---

1. Convection oven with two (2) oven racks.
2. Stainless steel front, sides.
3. 3/4" rear gas connection.
4. 10" high stainless steel backguard.
5. Manual rotary ignitor with flame safety device.
6. Heavy duty casters, two (2) with brakes.
7. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48" Gas Conn. Kit, 48" long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
8. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.

ITEM NO. 644 ELECTRIC CORD REEL

QUANTITY 6

Manufacturer: By Electrical Contractor
Model: ---
Size and Shape: Refer to drawings

Alternate: ---

1. Provided by Trade Contractor.

ITEM NO. 660

CHARBROILER W/STAND

QUANTITY 1

Manufacturer: Vulcan
Model: VCCB36
Size and Shape: Refer to drawings
Alternate: Southbend, Wolf, Jade, Garland

1. Gas countertop charbroiler.
2. Cast iron radiants.
3. Standing pilot.
4. Individual manual burner controls.
5. S/S front, sides, and back.
6. Adjustable grates.
7. S/S Stand with Marine edge and undershelf.
8. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48" Gas Conn. Kit, 48" long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.
9. Provide Eagle model CC-S, Stainless Steel Caster Cradle Stabilizing Device for all mobile production equipment under the exhaust hoods. Coordinate locations with the Owner prior to installation. Quantity One (1) equals One (1) lot. Alternate: Regency Stainless Steel Caster Placement System, model #600Safetyset.

ITEM NO. 701

FRYER BATTERY - 2 BANK

QUANTITY 2

Manufacturer: Frymaster
Model: FPPH255
Size and Shape: Refer to drawings
Alternate: Vulcan

1. Two (2) Gas fryer with 50 lb. oil capacity banked together.
2. Manual solid state controls with melt cycle.
3. S/S fry tank and twin baskets. Provide extra set of twin baskets.
4. S/S cabinet.
5. S/S legs.
6. Built-in filter system.
7. Fry pot cover.
8. Cord and plug assembly.
9. One (1) PSDU-100 mobile oil disposal unit.
10. Four (4) casters two (2) with brakes.
11. Fryer Banking Strips.
12. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48" Gas Conn. Kit, 48" long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.

13. Spreader cabinet Food Warmer and Holding Station with Heat lamp.

ITEM NO. 801

SALAMANDER

QUANTITY 1

Manufacturer: Vulcan
Model: 36IRB-N
Size and Shape: Refer to drawings
Alternate:

1. Mount to shelf.
2. Coordinate routing of gas line with equipment.
3. Secure to back riser.
4. Provide quantities and sizes required: Dormont Model #VER-KIT-2S-48" Gas Conn. Kit, 48" long, Moveable Gas Connector Kit, covered with stainless steel braid, coated with blue antimicrobial PVC, SnapFast® Quick Disconnect, Swivel MAX®, full port valve, coiled restraining cable with hardware, limited lifetime warranty.

END OF CULINARY

FLORAL COOLER

ITEM NO. 103

REFRIGERATION SYSTEM-STANDARD

QUANTITY 1

Manufacturer: RDT
Model: ZS1-2 EcoSmart
Size and Shape: Refer to drawings
Alternate:

1. Air cooled system.
2. Scroll Compressors.
3. Cooler temperature to be +35 degrees.
4. EcoSmart system on demand defrost.
5. KE2 Evap Controllers located per Owner requirements
6. S/S covered housing.
7. A dedicated electrical connection to be provided for heated condensate drain line. Refer to electrical plan for location.
8. All exterior piping to be aluminum wrapped.
9. System to accommodate Item No. 800 Floral Display Cooler and Item No. 802 Floral Cooler Storage Assembly.
10. S/S covered housing mounted to a 24" tall 1/8 galvanized angle iron frame anchored to concrete pad. Provide S/S skirting around frame.

FOOD SERVICE EQUIPMENT

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11. Mount condensing unit on common exterior rack. Refer to Architectural and Engineering drawings for exact location of remote unit. Coordinate routing of refrigeration lines and conduit with appropriate trades. Heat tape and insulate all drain lines. General Contractor to seal all building penetrations at refrigeration lines.
12. Provide two (2) year parts and labor warranty for all parts and components (including third-party components that may be utilized).

ITEM NO. 104 COLD STORAGE SHELVING

QUANTITY 1

Manufacturer: Metro
Model: Metro Max Q
Size and Shape: Refer to drawings
Alternate:

1. Each unit to be four (4) tiers high with open grid mats.
2. Four (4) 74" post per unit. Provide foot plates at all posts when assembly is supplied with walk-in floor.
3. Refer to drawings for size, width and lengths.
4. Quantity Two (2) to equal One (1) lot: all shelving shown within cold storage assembly.
5. Verify shelving requirements with approved submittal prior to ordering.

ITEM NO. 800 FLORAL DISPLAY

QUANTITY 1

Manufacturer: ThermoKool
Model:
Size and Shape: Refer to drawings
Alternate: American Panel, Kolpak

1. S/S finish where exposed
2. Interior walls aluminum embossed texture and ceiling to be smooth white enamel
3. 18 gauge S/S enclosure panels to 2" A.F.C..
4. One (1) Lot LED light fixtures with bulbs.
5. Floorless assembly; on slab, V-Channel base sealed at interior and exterior. All panels must be sealed at all seams.
6. Coordinate installation of STYLELINE Fixed Windows and STYLELINE CL Door & Frame system.
7. Provide STYLINE Flat Shelving.
8. **Coordinate wall opening size with door assembly. S/S trim at exterior.**
9. Pressure relief port to be sized per manufacturers recommendations

ITEM NO. 802 FLORAL COOLER STORAGE ASSEMBLY

QUANTITY 1

Manufacturer: ThermoKool
Model: ---
Size and Shape: Refer to drawings
Alternate: American Panel, Kolpak

1. S/S finish where exposed
2. Interior walls aluminum embossed texture and ceiling to be smooth white enamel
3. 18 gauge S/S enclosure panels to 2" A.F.C..

4. One (1) Lot LED light fixtures with bulbs.
5. Floorless assembly; on slab, V-Channel base sealed at interior and exterior. All panels must be sealed at all seams.
6. **Coordinate wall opening size with door assembly. S/S trim at exterior.**
7. Pressure relief port to be sized per manufacturers recommendations
8. Procurement and provision of Floral storage assembly installation is to be by manufacturer only. Submittal drawings to include letter confirmation of manufacturer installer
9. 304 #3 finish 20 gauge stainless steel finish where exposed, 20 gauge galvanized steel where concealed.

END OF FLORAL COOLER

END OF SECTION 11 40 00

SECTION 11 46 83 - ICE MACHINES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Commercial ice machines
 - 2. Appliance coordination including service connections, supply lines, and power
 - 3. Accessories necessary for a complete installation
- B. Related Sections:
 - 1. Division 22: Domestic water supply.
 - 2. Division 26: Electrical connection.

1.3 SUBMITTALS

- A. Product Data: Technical data including product specifications, installation, and maintenance instructions.
- B. Product Certificates: Submit certificate from product manufacturer stating compliance with requirements and intended use of product.
- C. Operation and Maintenance Data: Submit for each residential appliance to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
 - 3. Energy Ratings: Provide energy efficient appliances that carry labels indicating energy cost analysis (estimated annual operating costs) and efficiency information.
 - 4. Accessibility Requirements: Comply with applicable requirements.
 - a. United States Access Board Americans with Disabilities Act Accessibility Guidelines (ADAAG) (2010 ADA Standards for Accessible Design).
 - b. ICC A117.1 Accessible and Useable Building and Facilities.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for product's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
- C. Source Limitations: Obtain light commercial appliances from single source and each type of light commercial appliance from single manufacturer.
- D. Preinstallation Conference: Conduct conference at site.

1.5 WARRANTY

- A. Warranties: Written warranty signed by manufacturer in which manufacturer of the specific appliance specified agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.

1. Provide appliance and equipment rated for light commercial grade or higher. Residential appliances are not acceptable unless manufacturer warrants residential units in a commercial application and only with Architect's approval.
- B. Ice maker, Sealed System: Full warranty, including parts and labor, for onsite service on the product.
 1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
 2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 APPLIANCES

- A. Freestanding Unit Ice Machine (Ice Maker and Bin):
 1. Basis of Design: Products manufactured by Manitowoc.
 2. Description: Undercounter with Legs Air cooled with ice production approximately 425 lb (193 kg) per day at air temp of 70 degrees F (21 degrees C) and water temperature of 50 degrees F (10 degrees C).
 3. Dimensions: 24 inches wide by 39 inches high (610 mm by 990 mm).
 4. Finish: Stainless Steel.
 5. Ice Production: Minimum 425 pounds (193 kg) with 90 lb (41 kg) ice bin storage
 6. Refrigerant: R404A.
 7. Electrical: UL listed, 115V, 60 Hz, 1 phase; 8 amp; provide minimum 7 foot cord and NEMA 5-15 plug with each ice maker.
 8. Cube Type: Chewlet.
 9. Stainless steel evaporator, auger, top bearings, heavy duty tapered roller bearings, and low water safety circuit. NSF, ETL and CE listed depending on voltage requirement.
 10. Accessories: Ice scoop and related accessories necessary for a complete installation and use.
- B. Freestanding Ice Machine and Ice Bin:
 1. Basis of Design: Products manufactured by Manitowoc.
 2. Description: Freestanding with Legs Air cooled with ice production approximately 525 lb (238 kg) per day at air temp of 70 degrees F (21 degrees C) and water temperature of 50 degrees F (10 degrees C).
 3. Dimensions: 24 inches wide by 39 inches high (610 mm by 990 mm).
 4. Finish: Stainless Steel.
 5. Ice Production: Minimum 525 pounds (238 kg) with 536 lb (244 kg) ice bin storage
 6. Refrigerant: R404A.
 7. Electrical: UL listed, 115V, 60 Hz, 1 phase; 8 amp; provide minimum 7 foot cord and NEMA 5-15 plug with each ice maker.
 8. Cube Type: Cube.
 9. Stainless steel evaporator, auger, top bearings, heavy duty tapered roller bearings, and low water safety circuit. NSF, ETL and CE listed depending on voltage requirement.
 10. Accessories: Ice scoop and related accessories necessary for a complete installation and use.
- C. Appliances, Equipment, and Fixtures: Coordinate equipment, fixtures, appliances regardless which party provides or furnishes. Ensure adequate power supply and properly locate plumbing lines and hook ups, water and drain connections and accessories.
- D. Accessories: Provide accessories necessary for a working installation.

2.2 FINISHES

- A. Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Stainless Steel Finish: Provide appliances with standard finish complying with manufacturer's written instructions for surface preparation including ground and polished stainless steel surfaces for uniform, directionally textured finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances and conditions affecting performance of work. Coordinate installation of equipment, appliances, fixtures, and other items.
 - 1. Examine roughing in for piping systems and verify actual locations of piping connections before equipment installation.
 - 2. Examine electrical circuits and rating and verify locations and sufficient ratings for items requiring electrical power.
 - 3. Examine space to receive items and verify the space is of sufficient size and configuration for items.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions. Install fixtures level and plumb according to roughing in drawings.
- B. Power Supply: Coordinate power supply, grounding, outlets, and electrical wiring with locations indicated for appliances and equipment.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to plumbing and electrical sections for plumbing and electrical requirements.
- E. Connections and Hook ups: Coordinate location of services.
 - 1. Grounding: Ground equipment in accordance with applicable standards and code requirements.
 - 2. Wiring: Connect wiring in accordance with manufacturer recommendations.
 - 3. Provide necessary electrical outlets.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory authorized service representative:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturer written recommendations. Certify compliance with each manufacturer appliance performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Test each equipment item to verify proper operation. Make necessary adjustments. Replace malfunctioning appliances and components, then retest. Repeat procedure until units operate properly.

3.4 CLEANING

- A. Clean equipment with manufacturers' recommended cleaning methods and materials. After completing installation of equipment and fixtures, inspect exposed finishes and repair damaged finishes. Remove packing materials from site.

3.5 PROTECTION

- A. Provide protective covering for installed appliances. Do not allow use of equipment items for temporary facilities.

3.6 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 11 46 83

SECTION 11 57 00 - VOCATIONAL AND SHOP EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Welding booths.
 - 2. Downdraft Tables.
 - 3. Floral Pot Filler.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking.

1.3 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASME BPVC - Boiler and Pressure Vessel Code; 2023.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- J. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of laboratory equipment with laboratory casework and Owner-furnished, Owner-installed laboratory equipment.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS

- A. Refer to Section 01 40 00 - Quality Requirements for submittal procedures.
- B. Product Data: Provide equipment dimensions and construction; equipment capacities; physical dimensions; utility and service requirements, clearances, and locations; required accessories and optional features; and point loads.

- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and installation and servicing clearances required.
- D. Samples: Submit two samples of exposed finish surfaces, a minimum of 6 by 6 inches (150 by 150 mm) in size illustrating color and finish.
- E. Operation Data: Include description of equipment operation and required adjusting and testing .
- F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in the Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and approved by manufacturer.
- C. Preconstruction Testing: Factory-test each type of equipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package each piece of equipment to ensure protection from damage during shipment and delivery. Legibly indicate on the exterior of each container or crate, the shipping address and a brief description of its contents. Outside of the container, fasten a waterproof envelope containing a packing list and complete instructions for uncrating and setting the equipment in place.
- B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for materials, parts, and labor for sterilizer chamber.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 EQUIPMENT

- A. General Conditions:
 - 1. Prewire and prepipe each unit of equipment complete with trim and fittings. Include reduced pressure or atmospheric type backflow preventer fitting to prevent backflow of polluted water or waste into water supply system or equipment. Comply with applicable code requirements.
 - 2. Securely affix a plate which includes the manufacturer's name, address, and catalog or serial number to each equipment item. If applicable, include pressure vessels bearing the ASME stamp and pressure rating, indicating compliance with applicable code requirements.

3. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and closure trim required for complete installation.
 4. Use corrosion-resistant materials for all rivets, bolts, nuts, studs, spacers, and welding metal.
 5. Fully assemble equipment in factory, except for those items which cannot be moved to their final locations as single item.
- B. Welding Equipment: OFCI.
1. Booths:
 - a. Basis of Design: Double Welding Booth Model FD-WB-510 manufactured by Fume Dog.
 - b. Size: 10 feet wide by 5 feet deep.
 - c. Material: 12 gauge steel.
 - d. Finish: Powder coat.
 - 1) Color: As selected by the Architect from manufacturer's full line.
 2. Curtain and Rod:
 - a. Basis of Design: Model FD-WB-ROD5.
 - b. Size: 5 feet.
 3. Fume Extractor:
 - a. Basis of Design: Model FD-WM-BD-87H-EX manufactured by Fume Dog.
 4. Light Kit.
 5. Red Alert Light:
 - a. Basis of Design: FD-WB-AL manufactured by Fume Dog.
 6. Table.
 7. Tool Tray.
- C. Portable Downdraft Tables: OFCI.
1. Basis of Design: Model DDT-3x2, Airflow 1200 CFM as manufactured by Clean Air Industries.
 2. Face Velocity: 265 FPM.
 3. Motor: 120v/1/60 HZ.
 4. Amps: 16.7.
 5. Width: 40 inches.
 6. Height: 76 inches.
 7. Depth: 24 inches.
 8. Weight: 400 lbs.
- D. Floral Pot Filler:
1. Basis of Design: Dosing System as manufactured by Floralife.
 2. Features:
 - a. UL Rated up to 125 psi.
 - b. NSF51 specified hoses.
 - c. On/ Off push button.
 - d. Corrosion Resistant.

2.3 MATERIALS

- A. Aluminum Sheet: ASTM B209/B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.
 1. Finish: AAMA 2603.
- B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.
- C. Steel Sheet: ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed, ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed,

ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed, or ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate.

- D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 and 316, stretcher-leveled standard of flatness.
- E. Laminated Safety Glass: ASTM C1172.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Fasteners: Stainless-steel, or other corrosion-resistant materials, standard with the manufacturer.
- H. Welding Materials: Comply with ASME BPVC SEC II-C.
- I. Metal Finishes: Comply with NAAMM AMP 500-06.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with standards required by authority having jurisdiction.
- C. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- D. Mounting: Anchor equipment securely in place.
 - 1. Mount equipment in compliance with SMACNA (SRM) requirements.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner, and their locations are coordinated with equipment rough-in requirements.
 - 1. Require manufacturer's installer to supervise connection to utilities being performed by mechanical and electrical trades.
 - 2. Make connections between ferrous and nonferrous metallic pipe with dielectric waterways and flanges having temperature and pressure rating equal to or greater than that specified for the connecting piping. Use dielectric waterways internally lined with an insulator specifically designed to prevent current flow between dissimilar metals.
 - 3. Connect steam lines on equipment to building source only after building steam lines have been cleaned of preservatives and materials that may be harmful to the equipment.
- F. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by the Architect.

3.3 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform functional testing in accordance with referenced specification requirements. Test one item or similar model, as necessary or appropriate, to ensure that it is operational and installation complies with specification requirements.

3.4 ADJUSTING

- A. Adjust operating equipment to efficient operation.

3.5 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to the Owner. Replace any parts that cannot be repaired in such a manner.

END OF SECTION 11 57 00

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SECTION 11 61 00 - BROADCAST, THEATER, AND STAGE EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cyclorama components.
 - 2. Accessories as required for a complete installation.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures.
 - 2. Section 01 74 19 - Construction Waste Management and Disposal.
 - 3. Section 01 77 00 - Closeout Procedures.
 - 4. Section 07 92 00 - Joint Sealants: Sealant for soft joints.
 - 5. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board partitions and .
 - 6. Section 09 90 00 - Painting and Coating: Paint.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide product information including flame spread and smoke generated information, manufacturer's installation instructions, and maintenance information.
- C. Shop Drawings: Indicate installation sequence (if applicable), locations, and orientation as well as component quantities.
- D. Manufacturer's qualification statement.
- E. Fabricator's qualification statement.
- F. Executed warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Package for protection against transportation damage.
 - 2. Provide markings to identify components consistently with drawings.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - 1. Store in well-ventilated space out of direct sunlight.
 - 2. Protect from moisture and condensation.
 - 3. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

- B. Manufacturer Warranty: Provide manufacturer's standard warranty. Complete forms in Owner's name and register with manufacturer.
- C. Installer Warranty: Provide standard warranty commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with installer.

PART 2 PRODUCTS

2.1 CYCLORAMA

- A. Manufacturers:
 - 1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. ProCyc Inc.: www.procyc.com.
 - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 - 3. Source Limitations: Furnish products produced by a single manufacturer.
- B. Non-Parabolic Corner Modules:
 - 1. Basis of Design:
 - a. System Super 2.5EZ manufactured by ProCyc Inc.
 - 2. Material:
 - a. Acrylonitrile Butadiene Styrene (ABS) terpolymer.
 - 3. Floor Coves:
 - a. 30 inch vertical radius.
 - 4. Corner Coves:
 - a. 36 inch horizontal radius.
- C. Paint: Refer to Section 09 90 00 - Painting and Coating.
- D. Flooring: Refer to Section 09 65 00 - Resilient Flooring.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that conditions are acceptable for work. Notify Architect immediately of unacceptable conditions. Proceeding with installation will constitute acceptance of conditions.

3.2 PREPARATION

- A. Prepare for installation in accordance with manufacturer's written instructions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.

3.4 CLEANING

- A. Refer to Section 01 73 00 - Execution for additional requirements.
- B. Clean installed products as recommended by manufacturer.

3.5 PROTECTION

- A. Protect installed products from subsequent construction operations.

END OF SECTION 11 61 00

SECTION 11 61 33 - RIGGING SYSTEMS AND CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe Grids.
- B. Related Sections:

1.3 PERFORMANCE REQUIREMENTS

- A. Pipe grid shall withstand structural loads indicated using allowable design working stresses of material specified. Pipe grid shall be designed for a live load of 10 pounds per square foot. Factor of safety shall be 8.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Meeting to include the Owner's Designated Representative (ODR), the Architect, the Contractor, fabricator's representative, installer, and representatives of related trades.

1.5 SUBMITTALS

- A. Shop drawings indicating layout, design details, materials, and method of construction.

1.6 QUALIFICATIONS

- A. Installer Qualifications: Installer shall be experienced in providing and installing equipment of the kind indicated and shall have a record of successful in-service performance.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty. Complete forms in Owner's name and register with manufacturer.
- C. Installer Warranty: Provide 2-year warranty commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with installer.
- D. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.
- E. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
 - 1. Pipe Grids:
 - a. IWEISS: www.iweiss.com.
 - b. PipeGrids.com: www.pipegrids.com.
 - c. Stagecraft Industries, Inc.: www.stagecraftindustries.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 PIPE GRIDS

A. Materials and Components:

1. Pipe grid shall be installed at elevation indicated on Drawings.
2. Pipe grid shall consist of two sets of pipe battens installed (in plan) perpendicular to each other. Individual pipe battens in each set shall be located on 4 foot centers. End of pipe battens shall rest on clip angles (3 inches by 2 inches by 1/4 inch) on all sides of studio that have masonry walls secured in place by means of "U" bolts at ends of pipes.
3. Pipe battens that compose the grid (in both directions) shall consist of 1-1/2 inch O.D. steel pipe (schedule 40) with battens that span from wall to wall or as indicated on the Drawings.

B. Hangers:

1. Grid shall be supported by means of 1/4 inch welded link proof coil chain hangers or as detailed. Entire grid shall be assembled into a unit structure. Hangers shall be located on centers not to exceed 10 feet.
2. At every point where pipe battens intersect (in both directions) a fitting shall connect the two perpendicular pipes into a rigid assembly.
3. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperature. Attach hangers to structural members. After installation this contractor shall test working parts, correcting any items needing adjustment to assure easy and efficient operation.

C. Loads:

1. Pipe batten loads shall be referred to the overhead structure. Miscellaneous angles and channels as required shall be provided to transfer the hanger loads to the structure.
2. Fittings that connect the pipe battens at each intersection shall be formed to the precise size of the pipe battens and the two halves of the fitting shall be bolted together with four 3/8 inch, grade 5 bolts secured with lock nuts.

D. Finish:

1. As selected by Architect from manufacturer's full line.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Coordinate work with other trades doing adjoining work to assure proper fit, installation, and first class results.
- B. Where width of ducts and other building equipment interferes with locations of hangers at spacing required by standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support the loads within performance limits.

3.2 PROTECTION

- A. Protect installed pipe grid from subsequent construction operations.

3.3 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for additional submittals.

END OF SECTION 11 61 33

SECTION 11 66 23 - GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Basketball backboards, goals, and support framing.
 - 2. Gymnasium exercise equipment.
 - 3. Floor anchors for tensioned elements.
 - 4. Floor sleeves for net and goal posts.
 - 5. Wall mounted protection pads.
 - 6. Indoor netting enclosures.
 - 7. Volleyball nets and posts.
- B. Related Requirements:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete floor slab to receive floor sleeves and anchors.
 - 2. Section 05 12 00 - Structural Steel Framing: Structural members supporting basketball systems.
 - 3. Section 05 50 00 - Metal Fabrications: Secondary structural members supporting gymnasium equipment.
 - 4. Section 09 64 66 - Wood Gymnasium Flooring: Gymnasium flooring.
 - 5. Section 09 65 66 - Resilient Athletic Flooring: Gymnasium flooring.
 - 6. Division 26 - Electrical.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Refer to Section 01 21 00 - Allowances for cash allowances affecting this section.

1.4 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- B. Electrically Operated Equipment: Coordinate location and electrical characteristics of service connection.

1.6 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

- B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
 - 1. Electrical characteristics and connection locations.
 - 2. Fire rating certifications.
 - 3. Manufacturer's installation instructions.
- C. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gauge of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.
- D. Erection Drawings: Detailed dimensional requirements for proper location of equipment.
- E. Samples: Submit samples of wall pad coverings in manufacturer's available range of colors.
- F. Operating and maintenance data for each operating equipment item.
- G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and approved by manufacturer.
- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.
- B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.
- C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide 10 year manufacturer warranty.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Gymnasium Equipment:
 - a. ADP Lemco, Inc: www.adplemco.com/#sle.
 - b. AALCO.
 - c. ADP Lemco.
 - d. Draper, Inc: www.draperinc.com/#sle.
 - e. Grand Slam Safety, LLC: www.grandslamsafety.com/#sle.
 - f. IPI by Bison, Inc: www.ipibybison.com/#sle.
 - g. Performance Sports Systems: www.perfsports.com/#sle.

- h. Porter Athletic Equipment Company: www.porterathletic.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 GENERAL REQUIREMENTS

- A. See drawings for sizes and locations, unless noted otherwise.
- B. Where mounting dimensions or sizes are not indicated, comply with applicable requirements of the following:
 - 1. National Federation of State High School Associations (NFHS) sports rules.
- C. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of Contract Documents.
- D. Hardware: Heavy duty steel hardware, as recommended by manufacturer.
- E. Electrical Wiring and Components: Comply with NFPA 70; provide UL-listed equipment.
- F. Structural Steel Fabrications: Welded in accordance with AWS D1.1/D1.1M, using certified welders.

2.3 BASKETBALL

- A. Basketball System: Backstop assembly, backboard, and goal.
 - 1. Manufacturers:
 - a. ADP Lemco, Inc: www.adplemco.com/#sle.
 - b. AALCO.
 - c. ADP Lemco.
 - d. Draper, Inc: www.draperinc.com/#sle.
 - e. IPI by Bison, Inc: www.ipibybison.com/#sle.
 - f. Porter Athletic Equipment Company.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Ceiling-Suspended Backstop Assemblies: Capable of mounting both rectangular and fan-shaped backboards.
 - 1. Framing: Center strut; forward folding framing.
 - 2. Folding Control System: Electric hoist that folds backstop with 115 volt actuator, integral limit switches that provide automatic shut-off in both positions, and safety catch with automatic reset.
 - 3. Folding Control System: Manual winch with safety catch and automatic reset.
 - 4. Height Adjuster: Raises or lowers assembly by 2 feet (610 mm) to adjust goal height.
 - a. Height Control System: Electric hoist that adjusts backstop with 115 volt actuator, and integral limit switches that provide automatic shut-off in both positions.
 - b. Height Control System: Electric winch.
 - 5. Framing Color: Manufacturer's standard.
 - 6. Weight: 3400 lbs, maximum.
 - 7. Backstop Safety Device: Designed to limit free fall if support cable, chains, pulleys, fittings, which or related components fail with mechanical automatic reset; 6000 lb load capacity, one per folding backstop.
 - 8. Key Operation: Operating mechanism to be compatible with AssaAbloy SFIC Cores.
 - 9. Manufacturers:
 - a. Draper, Inc; EZ Fold Ceiling Suspended Forward-Folding: www.draperinc.com/#sle.
 - b. Draper, Inc; EZ Fold Ceiling Suspended Rear-Folding: www.draperinc.com/#sle.
 - c. IPI by Bison, Inc; IP1360FF Forward Fold, Front Braced: www.ipibybison.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Backboards: Tempered glass, rectangular shaped.
 - 1. Frame: Brushed aluminum edge, steel mounting.

2. Provide conversion frame, mountable on both assemblies designed for fan shaped backboards and assemblies designed for rectangular backboards.
 3. Dimensions: 42 inches high by 72 inches wide
 4. Thickness: 1/2 inch.
 5. Markings: Painted.
 6. Provide safety padding for bottom edge of backboard.
 7. Provide mounting kit.
 8. Color: Manufacturer's standard.
 9. Manufacturers:
 - a. Draper, Rectangular Glass, 72 inches by 42 inches.
 - b. Porter Rectangular Glass, 72 inches by 42 inches.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Goals: Steel rim, mounted to backboard, with attached nylon net; complete with mounting hardware.
1. Net Attachment Device: Tube-tie.
 2. Breakaway mechanism, adjustable.
 3. Provide safety pad for goal mounting.
 4. Finish: Powder coat orange.

2.4 FLOOR-MOUNTED EQUIPMENT

- A. Volley Ball Nets and Posts: One court system of adjustable posts, net, and tensioning winch meeting requirements for FIVB, USA Volleyball, NCAA and NFHS competition requirements.
1. Posts: 3-1/2 inch (89 mm) O.D. schedule 80 aluminum tube with 1 inch (25 mm) height adjustments between 42 and 96 inches (1.07 and 2.4 m).
 2. Net: 4 inch (101 mm) square #36 nylon cord with vinyl coated polyester hem, double stitched around the perimeter.
 - a. Top Hem Reinforcing: 2000 pound (907 kg) minimum break strength galvanized aircraft cable in nylon coating.
 - b. Bottom Hem Reinforcing: 1/4 inch (6.3 mm) diameter braided nylon rope with spring loaded, pressure type rope tensioner.
 - c. Size: Regulation size.
 3. Tensioning Winch: Manual crank heavy duty, self-locking worm gear mechanism.
 4. Antenna and boundary marker.
 5. Protective Pads: Polyethylene foam covered with polyester reinforced vinyl fabric.
 - a. Size: 72 inches, one per post standard.
 - 1) Comply with NCAA and NFHS Requirements.
 - b. Color: Black.
 6. Manufacturers:
 - a. Draper, Inc; Power Volleyball System (PVS): www.draperinc.com/#sle.
 - b. IPI by Bison, Inc; VB1000NS Centerline Aluminum: www.ipibybison.com/#sle.
 - c. AALCO.
 - d. ADp Lemco.
 - e. American Athletic.
 - f. Douglas Industries.
 - g. Performance Sports Systems.
 - h. Porter Athletic Company.
 - i. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Floor Anchors for Portable Gymnasium Equipment: Steel plate bolted into wood flooring, with center screw-down button for securing tensioned elements; installed flush with finish floor surface.

1. Specific equipment items to be anchored have not yet been determined; anchors in gymnasium floor are required.
 2. Anchors will be furnished by Owner and installed by Contractor.
 3. Screw Size: 1/2 inch (12.7 mm) diameter, with 13 threads per inch.
 4. Manufacturers:
 - a. ADP Lemco, Inc: www.adplemco.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Floor Sleeves for Posts: Metal sleeve, with latch cover, cast into concrete subfloor to hold poles for nets and goals; installed flush with finish floor surface.
1. Latch Cover: Brass, round; tamper resistant lock with key.
 2. Sleeve: Aluminum.
 3. Round Pole Diameter: 4 inches.
 4. Depth of Sleeve: 9 inches (230 mm) from floor surface to bottom, including latch cover.
 5. Elevated Floor Slabs: Provide sleeve retainer to be bolted to the underside of the floor slab.

2.5 WALL PADDING

- A. Wall Padding: Foam filling bonded to backing board, wrapped in covering; each panel fabricated in one piece.
1. Surface Burning Characteristics: Flame spread index (FSI) of 25 or less, smoke developed index (SDI) of 450 or less, Class A, when tested in accordance with ASTM E84 as a complete panel.
 2. Flammability: Comply with NFPA 286.
 3. Covering: Vinyl-coated polyester fabric, mildew and rot resistant; stapled to back of board.
 - a. Color: Black.
 - b. Texture: Embossed leather-look.
 - c. Custom Graphics: To be supplied by Owner.
 - 1) Location: Center Panels.
 - d. Fabric Weight: 14 oz/sq yd (0.52 kg/sq m), minimum.
 4. Foam, Fire-Rated: Open cell polychloroprene (Neoprene), with 5.5 pcf (90 kg/cu m) nominal density.
 5. Foam Thickness: 1-1/2 inches (38 mm).
 6. Backing Board: Plywood.
 - a. Thickness: 3/8 inch (9.5 mm), minimum.
 7. Panel Dimensions: Refer to Drawings.
 8. Fastening Margins: 1 inch (25 mm) wide, covered by fabric covering.
 9. Mounting: Permanent; using screws.
 10. Mounting: Removable; Z-clips fixed to wall and to padding.
 11. Manufacturers:
 - a. ADP Lemco, Inc; Model 200 Safety Wall Pads: www.adplemco.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Specially Shaped Padding: Same construction as standard padding; custom fabricate to fit irregularly shaped members, areas, and protrusions in gymnasium as indicated; provide padding for:
1. I-beams.
 2. Wall corners.
 3. Stage corners.
- C. Round Column Padding: Same construction as standard padding; made to fit; with grommet strip on each long side of pad, provide laces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.
- B. Inspect areas and conditions before installation, and notify Architect in writing of unsatisfactory or detrimental conditions.
- C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.
- D. Verify that electrical services are correctly located and have proper characteristics.

3.2 INSTALLATION

- A. Install in accordance with Contract Documents and manufacturer's instructions.
- B. Coordinate installation of inserts and anchors that must be built in to flooring or subflooring.
- C. Install equipment rigid, straight, plumb, and level.
- D. Secure equipment with manufacturer's recommended anchoring devices.
- E. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering.
- F. Separate dissimilar metals to prevent electrolytic corrosion.

3.3 ADJUSTING

- A. Verify proper placement of equipment.
- B. Verify proper placement of equipment anchors and sleeves, and use actual movable equipment to be anchored if available.
- C. Adjust operating equipment for proper operation; remove and replace equipment causing noise or vibration; lubricate equipment as recommended by manufacturer.

3.4 CLEANING

- A. Remove masking or protective covering from finished surfaces.
- B. Clean equipment in accordance with manufacturer's recommendations.

3.5 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Replace damaged products before Date of Substantial Completion.

END OF SECTION 11 66 23

SECTION 11 66 43 - INDOOR SCOREBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Basketball and Volleyball scoreboards.
 - 2. Accessories as necessary for a complete installation.
- B. Related Work:
 - 1. Section 05 50 00 - Metal Fabrications: Steel shapes required for those scoreboards requiring framing, posts, or other steel support either from ground or attachment to structures.
 - 2. Division 26 Electrical: Electrical requirements.
 - 3. All Sections regarding work to which scoreboards are attached.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and install procedures. Include details of joints, attachments, and clearances.
- C. Samples: Submit full range of colors, lettering styles, and finishes available for Architect's selection.

1.4 WARRANTY

- A. Warrant the work specified herein as follows:
 - 1. Scoreboards shall be guaranteed for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
 - 2. LED digits shall be guaranteed for ten (10) years against defects in materials.
- B. Defects shall include, but not be limited to, the following:
 - 1. Loose or missing parts.
 - 2. Severe deterioration of finish.
 - 3. Faulty operation, including, but not limited to burned out LED lamps.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Daktronics, Inc.
 - 2. Nevco Scoreboard Co.

2.2 BASKETBALL AND VOLLEYBALL SCOREBOARDS

- A. Basis of Design: Model 2750 as manufactured by Nevco.
- B. Features:

1. Home and Visitor score shall be incremented by one (1) from 0 to 199. Score may also be instantly cleared and reset by keypad entry to any score 0 to 199.
 2. Clock shall display time remaining up to 99:59. Clock shall be capable of counting up or down, and clock may be instantly reset to any desired time when clock is turned off.
 3. Quarters, 1-4, shall be displayed using a numeral lampbank.
 4. Double Bonus shot indicator for each team.
 5. Possession indicator for each team.
 6. Face-mounted horn shall sound manually when clock is turned off can sound automatically at end of period.
 7. Automatic substitution feature shall allow operator to program horn to sound automatically next time clock is turned off thus altering officials of substitution.
 8. Time-out timer shall display time remaining in time-out. Short horn blast shall provide 15 second warning for time-out. Control box speaker shall signal end of time-out.
 9. Fractional seconds feature shall show time left in period to 1/100 of a second.
 10. Team fouls shall be displayed from 0 to 99 for both Home and Visiting teams.
 11. Automatic Quarter Reset shall set up next quarter and advances period automatically.
 12. Bonus shall start automatically at the preprogrammed 5th or 7th team foul.
 13. Speaking controls "tell" the user how to get started.
 14. Lighted (LED) clock colon and decimal shall interact with the running time. Clock colons shall disappear and decimal point turn on to indicate time under 1:00.
- C. Dimensions: Scoreboard shall be 8 feet in length by 6 feet in height. Clock and score numeral displays shall be 14 inches high. Period, Fouls, Won, Bout, Player Number, Game, and Weight numeral displays shall be ten (10) inches high.
- D. Construction: Scoreboard face and scoreboard cabinet shall be made of 0.080 inch thick aluminum with premium urethane finish. Colors to be selected by Architect from manufacturer's full line.
- E. LED Digits (Light Emitting Diode): Digits shall utilize superbright LED lamps to form 14 inch amber Score digits and 14 inch red Clock digits. Bonus indicators shall be red LED, Possession indicators, colon and decimal shall be amber LED. LED digits shall be covered with 1/8 inch Lexan shields to protect and absorb ball impacts.
- F. Components: All electronic components shall be solid state. Component module shall be accessible from front of scoreboard.
- G. Console: Operator's control console shall not require 120 VAC electrical power. Low voltage control console shall be housed in a protective, weather-resistant carry case. A single ten (10) foot long, three (3) wire, low voltage control cable shall unplug and store inside carrying case. Furnish two (2) control consoles with carrying cases.
- H. Switches: Switching shall be accomplished by solid state membrane switching technology; each switch having a life of at least five (5) million operations. All switches shall be "splash proof" and environmentally sealed by a combination of layers of a velvetgrain, highly durable, polycarbonate and glossy polyester. All switches shall be defined by the 0.020 inch thick black velvetgrain polycarbonate "switch locator" overlay. Numeric keypad, clock on/off, and score switches shall give "tactile feedback" to recognition. Sound shall be emitted by all switches to let operator know a switch has occurred. Clock on/off switch shall be environmentally sealed "bat type" toggle switch. Visual feedback shall be accomplished by LED indicators (green) for clock and other selected switches (red). This gives three (3) methods of feedback to the operator: Tactile (feel), Audio (sound), LED/Coding (sight).
- I. Multi-Sport: Control panel switch functions shall be changed (depending on type of scoreboard being used; i.e., basketball, volleyball, football, soccer, wrestling, etc.) by removing a single switch label insert from under the overlay and re-inserting appropriate switch label insert. Insert shall slide in and out and locked in place. Each sport shall have a single switch label insert.

- J. Electrical: Scoreboard shall require not more than 2.5 amperes at 120 VAC, 60 Hz.
- K. Number/Location: As indicated on Drawings.

2.3 OTHER MATERIALS

- A. Provide other materials as produced by manufacturer of scoreboard, not specifically described, but required for a complete and proper scoreboard installation including, but not limited to, the following :
 - 1. Controller: Model MPCW7.
 - 2. Reciever: MPCW7.
 - a. Quantity: Two (2).
 - 3. Hard Carrying Case.
 - 4. Clock: Model 9715P
 - a. Quantity: Two (2).
 - 5. Clock: Model 9715C
 - a. Quantity: Two (2).
 - 6. Cat5 - 200 feet.
 - 7. 100 foot coax runs for reciever extension if necessary to gym area.
 - a. Qunantity Two (2).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install specified units in accordance with manufacturer's printed instructions. Erect units plumb and level, with power supply coordinated with the electrical Division.
- B. Install each scoreboard on framing and supports as indicated on drawings. Refer to Section 03 30 00 - Cast-In-Place Concrete for concrete footings of scoreboard posts as shown or required. Refer to Section 05 50 00 - Metal Fabrications for steel items incidental to framing and support of scoreboards as shown or required.
- C. Adjust each scoreboard for proper function. Replace broken lamps, faulty control elements, and damaged parts.
- D. Provide remote locations for additional controller hook-ups as indicated.

END OF SECTION 11 66 43 11 66 43

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SECTION 11 70 00 - HEALTHCARE EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including, but not limited to, the following:
 - 1. Section includes medical equipment; connection to utilities; and service fittings and outlets.

1.3 SUBMITTALS

- A. Section 01 33 00 "Submittal Procedures": Submittal requirements.
- B. Product Data: Submit manufacturer's specifications, application instructions, and recommendations. Include data substantiating product complies with requirements of the contract documents.
- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and clearances required.
- D. Samples: Submit two samples of exposed finish surfaces, in size illustrating color and finish.
- E. Manufacturer's Installation Instructions: Submit special installation requirements.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 73 00 "Execution": Closeout procedures.
- B. Project Record Documents: Record actual locations of concealed utility connections.
- C. Operation and Maintenance Data: Submit description of equipment operation, adjusting, and testing required. Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- D. Warranty: Submit Manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 COORDINATION

- A. Section 01 31 00 "Project Management and Coordination": Coordination and project conditions.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

- A. Refer to Section 01 81 13 "Sustainable Design Requirements" for requirements related to the following:
 - 1. Recycled content.
 - 2. Certified Wood.
 - 3. VOC limits of adhesives.
 - 4. VOC limits of sealants.
 - 5. VOC limits of paints and coatings.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to job site in sealed, unopened cartons or crates. Upon receipt, inspect the shipment to ensure it is complete, in good condition and meets project requirements.

- B. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.
- C. Store material under cover in a clean and dry location, protecting units against weather and defacement or damage from construction activities, especially to the edges of panels.

1.9 WARRANTY

- A. Section 01 73 00 "Execution": Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for medical equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Blickman, Inc.
 - 2. Hill-Rom
 - 3. Modular Services Company.
 - 4. Welch Allyn.

2.2 MEDICAL EQUIPMENT

- A. Headwall:
 - 1. Features:
 - a. Oxygen Flowmeter.
 - b. Medical air flowmeter.
 - c. Two (2) Humidifiers.
 - d. Two (2) Nasal Cannulas.
 - e. Suction tubing.
 - f. Preinstalled replica nurse call face plate.
 - g. Call button with cord.
 - 2. Size:
 - a. Height: 12.5 inches.
 - b. Width: 48 inches.
 - c. Depth: 4 inches.
 - 3. Finish: Powder Coat.
 - 4. Color: Custom color as selected by Architect.
 - 5. Basis of Design: Amico Sapphire 48" Headwall as manufactured by Pocket Nurse.
- B. Nursing Skills Bed: OFCI.
- C. IV Stand: OFOI.
- D. Bed Locator:
 - 1. Basis of Design: Bed Locator as manufactured by Amico.

2.3 COMPONENTS

- A. Equipment: Refer to Schedule on drawings.
- B. Rough-in: Frames, anchors, supports, accessories and closure trim; appropriate to scheduled equipment.

2.4 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Division 26 for wiring connections and requirements for electrical characteristics.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 31 00 "Project Coordination": Coordination and project conditions.
- B. Verify rough-in frames, anchors and supports are accurately placed.

3.2 PREPARATION

- A. Coordinate rough-in frame and anchor placement.

3.3 INSTALLATION

- A. Install in accordance with standards required by authority having jurisdiction.
- B. Anchor equipment securely in place.
- C. Sequence installation to accommodate required utility connections.
- D. Touch-up minor damaged surfaces caused during installation. Replace damaged components.

3.4 ADJUSTING

- A. Section 01 73 00 "Execution": Testing, adjusting, and balancing.
- B. Adjust operating equipment to efficient operation.

END OF SECTION 11 70 00

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SECTION 11 81 29 - FACILITY FALL PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof anchors.
 - 2. Horizontal lifeline systems.
 - 3. Ladder safety systems.
 - 4. Safety railings and gates.

- B. Related Sections:

1.3 ABBREVIATIONS AND ACRONYMS

- A. HLL: Horizontal Lifeline.
- B. IWCA: International Window Cleaning Association.
- C. RDS: Rope Descent System.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Anchorage.
 - 2. Anchorage Connector.
 - 3. Fall Arrest System.
 - 4. Fall Protection System.
 - 5. Fall Restraint System.
 - 6. Lifeline.

1.5 REFERENCE STANDARDS

- A. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- B. 29 CFR 1910.23 - Ladders; Current Edition.
- C. 29 CFR 1910.27 - Scaffolds and Rope Descent Systems; Current Edition.
- D. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- E. 29 CFR 1910.140 - Personal fall protection systems; Current Edition.
- F. 29 CFR 1910.66 - Powered Platforms for Building Maintenance; Current Edition.
- G. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.
- H. 29 CFR 1926.1053 - Ladders; Current Edition.
- I. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- J. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2023).
- K. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- L. ANSI/ASSP A10.32 - Personal Fall Protection Used in Construction and Demolition Operations; 2012.
- M. ANSI/ASSP Z359.11 - Safety Requirements for Full Body Harnesses; 2021.
- N. ANSI/ASSP Z359.12 - Connecting Components for Personal Fall Arrest Systems; 2019.

- O. ANSI/ASSP Z359.15 - Safety Requirements for Single Anchor Lifelines and Fall Arresters for Personal Fall Arrest Systems; 2014.
- P. ANSI/ASSP Z359.16 - Safety Requirements for Climbing Ladder Fall Arrest Systems; 2016.
- Q. ANSI/ASSP Z359.18 - Safety Requirements for Anchorage Connectors for Active Fall Protection Systems; 2017, with Errata (2021).
- R. ANSI/IWCA I-14 - Window Cleaning Safety Standard; 2001.
- S. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- T. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2023.
- U. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- V. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- W. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- X. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- Y. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- Z. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- AA. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- BB. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- CC. ASTM A1023/A1023M - Standard Specification for Carbon Steel Wire Ropes for General Purposes; 2021.
- DD. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- EE. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- FF. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- GG. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- HH. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- II. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- JJ. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- KK. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

LL. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of roof anchors with roofing manufacturer to verify installation will result in a warrantable building envelope.

1.7 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's data sheets on each ladder safety system product to be used, including installation instructions.
 - 2. Material, equipment, and fixture lists. Manufacturer's catalog data indicating the sizes, descriptions, capacities, test certifications, and other descriptive data showing in sufficient detail that product complies with contract requirements. Equipment and performance data including but not limited to lifeline anchors, safety tieback anchors, and lifeline cable.
- C. Shop Drawings:
 - 1. Installation drawings showing locations and types of anchorage points for personal fall protection systems and building maintenance equipment.
 - 2. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordination requirements with roof membrane system.
 - 3. Indicate anchorage details and quantity, diameter, and depth of penetration of anchors.
- D. Certificates:
 - 1. Certify that products of this Section meet or exceed specified requirements.
 - 2. Certify compatibility of all products installed under this Section with roofing system.
- E. Delegated Design Documents: Drawings and calculations sealed by Designer for fall protection system, indicating compliance with performance requirements and design criteria.
- F. Test Report: Indicating completion of proof load testing on installed systems.
- G. Manufacturer's Installation Instructions: Instructions indicating recommended method and sequence of installation for lifeline anchors, safety tieback anchors, energy-absorbing devices, and lifeline cable.
- H. Designer's qualification statement.
- I. Manufacturer's qualification statement.
- J. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- K. Installer's qualification statement.
- L. Testing agency's qualification statement.
- M. Operation Data: Provide operating instructions and identify unit limitations.
- N. Maintenance Data: Include parts list and maintenance requirements for equipment.

1.8 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.
- C. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

- D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 ROOF ANCHORS

- A. Manufacturers:
 - 1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. Guardian Fall Protection: www.guardianfall.com.
 - b. Pro-Bel Enterprises Ltd: www.pro-bel.ca.
 - c. Summit Anchor Company: www.summitanchor.com.
 - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- B. Application:
- C. Description:
 - 1. Roof anchorage points for personal fall protection systems; used exclusively for employee fall protection and independent of any anchorage used to suspend employees or platforms on which employees work.
 - a. Anchor Type per ANSI/ASSP Z359.18: Type T.
 - 2. Roof anchorage points for primary suspension lines for bosun's chairs, work cages, and suspended platforms used for window washing or facade access.
- D. Structural Performance: Provide safety tieback anchors capable of withstanding design loads as required by governing regulations and codes.
- E. Design Criteria: Fall protection anchors.
- F. Design Criteria: Primary suspension lines.
- G. Provide permanent labels with manufacturer's name, serial number, manufacturing date, and rated load on roof anchors.
- H. Anchors:
 - 1. Type: Vertical foam-filled steel pier and baseplate with galvanized forged steel loop.
 - a. Loop Diameter: 1-3/8 inch (35 mm).
 - b. Pier:
 - 1) Height: 12 inches (305 mm).
 - 2) Diameter: 3-inch (76-mm) OD.
 - 3) Wall Thickness: Schedule 40.
 - 4) Material: Hot-dip galvanized steel pipe.
 - 5) Foam: Polyurethane. ASTM E84 Class I.
 - 6) Threaded vent hole with stainless steel plug.
 - 2. Type: Steel anchorage plate with cast steel loop top.
 - a. Loop Diameter: 1-3/8 inch (35 mm).

- b. Flat Baseplate:
 - 1) Size: 6 inches (154 mm) square.
 - 2) Thickness: 3/8 inch (9.5 mm).
 - 3) Material: Hot-dip galvanized steel.
 - 4) Bolt Holes: Four 9/16 inch (14 mm) I.D. holes.
- I. Anchor Installation:
 - 1. Type: Cast-in-place.
 - 2. Anchor Substrate: Existing concrete deck.
 - 3. Roofing Material: As indicated on drawings.
 - 4. Flashing Material: Premolded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.

2.2 HORIZONTAL LIFELINE SYSTEMS

- A. Manufacturers:
 - 1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
 - a. 3M Personal Safety Division: www.3M.com/FallProtection.
 - b. Guardian Fall Protection: www.guardianfall.com.
 - c. Pro-Bel Enterprises Ltd: www.pro-bel.ca.
 - d. Super Anchor Safety: www.superanchor.com.
 - 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution
- B. Description: A system comprised of a flexible line such as wire rope or cable, with connectors at both ends to secure it horizontally between two anchorages or anchorage connectors.
- C. Structural Performance: Provide fall-arresting lifeline systems capable of withstanding design loads as required by governing regulations and codes.
- D. Design Criteria:
 - 1. Comply with ANSI/ASSP Z359.12.
 - 2. Comply with ANSI/ASSP Z359.15.
 - 3. Comply with 29 CFR 1926.502.
 - 4. Comply with ANSI/ASSP A10.32.
- E. Wire Rope: ASTM A1023/A1023M, 7x7 galvanized wire , 5/16 inch (8 mm) diameter.
 - 1. Stainless Steel Rigging Components: Consisting of turnbuckles, cable clamps, spring energy absorbers, absorber couplers, eye thimbles, bolts, and connector O-rings as required to make a complete and functional HLL system compatible with installed anchors.

2.3 LADDER SAFETY SYSTEMS

- A. Climbing Ladder Fall Arrest System (CLAFS):
 - 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) 3M Personal Safety Division: www.3M.com/FallProtection.
 - 2) MSA Safety Incorporated: www.msasafety.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and

- comply with Division 01 requirements regarding substitutions to be considered.
Submit as a substitution.
2. Description: Climbing ladder fall arrest system allows worker to climb up and down using both hands; does not require employee continuously, hold, push, or pull any part of system while climbing.
 3. Comply with 29 CFR 1910.29, 29 CFR 1926.1053, Section 7 of ANSI A14.3 and ANSI/ASSP Z359.16.
 4. Install on new fixed ladders over 24 feet (7315 mm) in height.
 5. Anchorage: Fixed ladder meeting requirements of 29 CFR 1910.23.
 6. Flexible Carrier: Fixed 3/8-inch (9.5 mm) diameter stainless steel wire rope lifeline with shock absorber and top, bottom, and intermediate supports, meeting requirements of ANSI/ASSP Z359.16.
 - a. Provide with stainless steel extension post at top of ladder, meeting requirements of ANSI/ASSP Z359.16.
 7. Rigid Carrier: Fixed 304 stainless steel U-shaped slotted track with top, bottom, and intermediate supports, meeting requirements of ANSI/ASSP Z359.16.
 - a. Provide with stainless steel extension post at top of ladder, meeting requirements of ANSI/ASSP Z359.16.
 8. Fall Arrester: Stainless steel and aluminum automatic pass-through carrier sleeve fall arrester meeting requirements of ANSI/ASSP Z359.15 and ANSI/ASSP Z359.16; compatible with carrier.
 - a. If designed to be removable from carrier, arrester removable only by at least two deliberate manual action(s) by user.
 - b. Includes an anti-inversion device to prevent installation of carrier sleeve upside down on carrier.
 - c. Carrier sleeve movement is automatic and does not require continuous manual intervention during climbing or descending.
 - d. Includes panic grab (secondary locking mechanism) feature.
- B. Ladder Safety System:
1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Guardian Fall Protection: www.guardianfall.com.
 - 2) Honeywell International, Inc: www.honeywell.com.
 - 3) Sellstrom Manufacturing Company: www.fallprotection.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
Submit as a substitution.
 2. Description: Ladder safety system allows the worker to climb up and down using both hands; does not require the employee continuously, hold, push, or pull any part of the system while climbing.
 3. Comply with 29 CFR 1910.29, 29 CFR 1926.1053, and Section 7 of ANSI A14.3.
 4. Install on new fixed ladders over 24 feet (7315 mm) in height.
 5. Anchorage: Fixed ladder meeting requirements of 29 CFR 1910.23.
 6. Flexible Carrier: Fixed 3/8-inch (9.5 mm) diameter stainless steel wire rope lifeline with shock absorber and top, bottom, and intermediate supports.
 - a. Provide with stainless steel extension post at top of ladder.
 7. Rigid Carrier: Fixed 304 stainless steel U-shaped slotted track with top, bottom and intermediate supports.
 - a. Provide with stainless steel extension post at top of ladder.

8. Fall Arrester: Stainless steel automatic pass-through carrier sleeve fall arrester; compatible with carrier.
- C. Personal Fall Arrest System Components; 29 CFR 1910.140:
 1. Manufacturers:
 - a. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1) Honeywell International, Inc: www.honeywell.com.
 - 2) 3M Personal Safety Division: www.3M.com/FallProtection.
 - 3) MSA Safety Incorporated: www.msasafety.com.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1) Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
 2. Body Support: Full body harness meeting requirements of ANSI/ASSP Z359.11; equipped with front or hip D-rings for attachment to climbing ladder fall arrest system.
 3. Connecting Means: Connecting hardware, such as a locking carabiner, meeting requirements of ANSI/ASSP Z359.12; compatible with fall arrester and body support harness.

2.4 PERMANENT SAFETY RAILINGS AND GATES

- A. Manufacturers:
 1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. Garlock Safety Systems: www.garlocksafety.com.
 - b. Guardian Fall Protection: www.guardianfall.com.
 - c. Kee Safety, Inc: www.keesafety.com.
 - d. Pro-Bel Enterprises Ltd: www.pro-bel.ca.
 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- B. Basis of Design:
- C. Design Criteria:
 1. Railing: Comply with 29 CFR 1910.29 and 29 CFR 1926.502 for fall protection.
 2. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable regulations.
 3. Distributed Loads: Design railing assembly and attachments to resist distributed force of 75 pounds per linear foot (1095 N/m) applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
 4. Concentrated Loads: Design railing assembly and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Railing Dimensions: Refer to Drawings for configurations and heights.
 1. Top Rails: 1-1/2-inch (38 mm) diameter, round.
 2. Intermediate Rails: 1-1/2-inch (38 mm) diameter, round.
 3. Posts: 1-1/2-inch (38 mm) diameter, round.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable, provide flush countersunk fasteners.

1. Posts: Provide adjustable flanged brackets.
 2. Surface Mounting Bases: Provide zip bases.
- F. Posts and Rails: Galvanized steel tubing.
- G. Gate: Same material as railing; automatic closing with latch.
- H. Finish: Manufacturer's standard, factory-applied finish.

2.5 NON-PENETRATING SAFETY RAILINGS

- A. Manufacturers:
1. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - a. Garlock Safety Systems: www.garlocksafety.com.
 - b. Guardian Fall Protection: www.guardianfall.com.
 - c. Kee Safety, Inc: www.keesafety.com.
 - d. Pro-Bel Enterprises Ltd: www.pro-bel.ca.
 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - a. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- B. Basis of Design:
1. Kee Guard Safety Rail manufactured by Kee Safety, Inc.
- C. Design Criteria:
1. Railing: Comply with 29 CFR 1910.29 and 29 CFR 1926.502 for fall protection.
 2. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable regulations.
 3. Distributed Loads: Design railing assembly and attachments to resist distributed force of 75 pounds per linear foot (1095 N/m) applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
 4. Concentrated Loads: Design railing assembly and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Railing Dimensions: Refer to Drawings for configurations and heights.
1. Top Rails: 1-1/4 inch (32 mm) diameter, round.
 2. Intermediate Rails: 1-1/4 inch (32 mm) diameter, round.
 3. Posts: 1-1/4 inch (32 mm) diameter, round.
- E. Roof Edge Protection: Provide freestanding KeeGuard Roof Edge Protection System, including pipe railings, uprights, bases, counterweights and fittings
1. Freestanding counterweighted guardrail system with 42 inch (1067 mm) minimum height to provide a pedestrian egress barrier on the roof to withstand a minimum load of 200 lb (90719 g) in any direction to the top rail per OSHA Regulation 29 CFR 1910.23.
 2. Pipe: Steel, 1-1/4 inch (32 mm) schedule 40, galvanized.
 3. Tube: Galvanized tube, 12 gauge, 1-1/2 inches, 1.90 inches (48 mm) OD
 4. Rails and Posts: Galvanized Tube, 12 gauge, 1-1/4 inch (32 mm) diameter.
 5. Counterweight Levers: Galvanized Tube, 12 gauge, 1-1/4 inch (32 mm) diameter.
 6. Mounting Bases: Steel bases are galvanized and are supplied with a rubber pad on underside of the component.
 7. Counterweights: Molded recycled PVC with one fixing collar per counterbalance.
 8. Fasteners: Stainless steel or galvanized.
- F. Provide slip-on, non-welded mechanical fittings to join lengths, seal open ends including, but not limited to, elbows, crossovers, T-shapes, and splice connectors.

- G. Posts and Rails: Galvanized steel pipe and tube.
- H. Finish: Manufacturer's standard, polyester, factory-applied finish.
 - 1. Color: As selected by Architect from manufacturer's full line.

2.6 MATERIALS - STEEL

- A. Structural Steel Sections: ASTM A36/A36M.
- B. Steel Plates, Shapes, and Bars: ASTM A6/A6M or ASTM A283/A283M.
- C. Steel Pipe: ASTM A53/A53M Grade B Schedule 40.
- D. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized in accordance with ASTM A153/A153M where connecting galvanized hardware components.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.7 FABRICATION

- A. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to appearance and performance.
- B. Grind off surplus welding material and ensure exposed internal corners have smooth lines.
- C. Fabricate system components of the same material unless otherwise indicated.
- D. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use.
- E. Fabricate joints in a manner to discourage water accumulation. Provide weep holes to drain all water that could accumulate in the exposed joints.

2.8 FINISHES

- A. Galvanizing: Hot-dip galvanize to minimum requirements of ASTM A123/A123M.
 - 1. Touch up abraded areas after fabrication using specified touch-up primer for galvanized surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine area for compliance with requirements for installation tolerances and other conditions related to this work.
- B. Confirm that the ladder structure to which the ladder safety system is installed can withstand the loads applied by the system in the event of a fall.

3.2 PREPARATION

- A. Coordinate location of fall protection equipment indicated to be attached to structural substrate or surface of roofing system and provide anchoring devices with templates, diagrams, and installation instructions.

3.3 INSTALLATION

- A. Install anchorage and fasteners in accordance with shop drawings and manufacturer's recommendations to obtain allowable working loads published in product literature and in accordance with this specification.

- B. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous coating or by other permanent separation as recommended by fall protection system manufacturer.
- C. Deform threads of tail end of anchor studs after nuts have been tightened to prevent accidental removal or vandalism.
- D. Do not load or stress anchors until all materials and fasteners are properly installed and ready for service.
- E. Seal roof penetrations at anchors with pre-molded pipe flashing, membrane flashing, or sealant acceptable to roof manufacturer.
- F. Install all roof safety anchors a minimum of 6 feet (1.83 m) from the roof edge.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Test anchorage systems using only chemical adhesive fasteners on-site using load cell test apparatus in accordance with manufacturer's recommendations.
- C. Load test anchors under the direct supervision of a licensed engineer in accordance with ACI 318, AISC 360, ASCE 7, ICC (IBC), 29 CFR 1910.27, 29 CFR 1910.66, and _____ requirements.
- D. Inspect each anchor for conformance to manufacturer requirements, building envelope, looseness, and signs of permanent deflection during load testing.

3.5 ADJUSTING

- A. Adjust fall protection components to function smoothly and safely.

3.6 CLEANING

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.
- C. Clean exposed surfaces in accordance with fall protection system manufacturer's written instructions.

3.7 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstration: Demonstrate operation of equipment to the Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.

3.8 MAINTENANCE

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.
- B. 29 CFR 1910 and ANSI/IWCA I-14 require that anchors first be certified and subsequently inspected on an annual basis. Coordinate with manufacturer and local inspectors as required to maintain compliance.
- C. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION 11 81 29

SECTION 11 90 00 - MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall Hooks.
 - 2. Drone Target Pulley System.
 - 3. Drone Charging Station.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking.

1.2 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASME BPVC - Boiler and Pressure Vessel Code; 2023.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- J. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of laboratory equipment with laboratory casework and Owner-furnished, Owner-installed laboratory equipment.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. Refer to Section 01 40 00 - Quality Requirements for submittal procedures.
- B. Product Data: Provide equipment dimensions and construction; equipment capacities; physical dimensions; utility and service requirements, clearances, and locations; required accessories and optional features; and point loads.
- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and installation and servicing clearances required.

- D. Samples: Submit two samples of exposed finish surfaces, a minimum of 6 by 6 inches (150 by 150 mm) in size illustrating color and finish.
- E. Operation Data: Include description of equipment operation and required adjusting and testing .
- F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and approved by manufacturer.
- C. Preconstruction Testing: Factory-test each type of equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package each piece of equipment to ensure protection from damage during shipment and delivery. Legibly indicate on the exterior of each container or crate, the shipping address and a brief description of its contents. Outside of the container, fasten a waterproof envelope containing a packing list and complete instructions for uncrating and setting the equipment in place.
- B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for materials, parts, and labor for sterilizer chamber.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 EQUIPMENT

- A. General Conditions:
 - 1. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and closure trim required for complete installation.
 - 2. Use corrosion-resistant materials for all rivets, bolts, nuts, studs, spacers, and welding metal.
 - 3. Fully assemble equipment in factory, except for those items which cannot be moved to their final locations as single item.
- B. Wall Hooks:
 - 1. Basis of Design: Hooks manufactured by Hangsafe Hooks.
 - 2. Materials: 2 inch stainless steel screws and finishing.
 - 3. Quantity and Location: Refer to Drawings.
- C. Drone Target Pulley System:
 - 1. Basis of Design: Drive Pulley Drop Kit as manufactured by Zip Targets.

2. SKU: ZT-DPDK.
 3. Included in Kit: Dual Pulley, Carabiner, Wood Screw Cup Hook, 8 foot cinch strap.
 4. Quantity and Location: Refer to Drawings.
- D. Drone Charging Station (Pegboard):
1. Basis of Design: Skadis pegboard as manufactured by IKEA.
 2. Material: Fiberboard.
 3. Metal Material: Steel.
 4. Dimensions: 30 inches Wide by 22 inches High.
 5. Quantity and Location: Refer to Drawings.
 6. Color: As selected by Architect from Manufacturer's full range.

2.3 MATERIALS

- A. Aluminum Sheet: ASTM B209/B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.
 1. Finish: AAMA 2603.
- B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.
- C. Steel Sheet: ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed or ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate.
- D. Stainless-Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 and 316, stretcher-leveled standard of flatness.
- E. Laminated Safety Glass: ASTM C1172.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Fasteners: Stainless-steel, or other corrosion-resistant materials, standard with the manufacturer.
- H. Welding Materials: Comply with ASME BPVC SEC II-C.
- I. Metal Finishes: Comply with NAAMM AMP 500-06.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide rough-in frame and anchors for placement by Section 01 25 13 - Product Substitution Procedures.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with standards required by authority having jurisdiction.
- C. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- D. Mounting: Anchor equipment securely in place.
 1. Mount equipment in compliance with SMACNA (SRM) requirements.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner, and their locations are coordinated with equipment rough-in requirements.

1. Require manufacturer's installer to supervise connection to utilities being performed by mechanical and electrical trades.
 2. Make connections between ferrous and nonferrous metallic pipe with dielectric waterways and flanges having temperature and pressure rating equal to or greater than that specified for the connecting piping. Use dielectric waterways internally lined with an insulator specifically designed to prevent current flow between dissimilar metals.
 3. Connect steam lines on equipment to building source only after building steam lines have been cleaned of preservatives and materials that may be harmful to the equipment.
- F. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Architect.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform functional testing in accordance with referenced specification requirements. Test one item or similar model, as necessary or appropriate, to ensure that it is operational and installation complies with specification requirements.

3.5 ADJUSTING

- A. Adjust operating equipment to efficient operation.

3.6 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to Owner. Replace any parts that cannot be repaired in such a manner.

END OF SECTION 11 90 00

SECTION 12 11 13 - PHOTO MURALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Very large scale vinyl wall graphics (murals) digitally printed on self-adhesive vinyl graphics film from electronic graphic image files furnished by the Architect, adhered to gypsum board surfaces with a Level 5 skim coated, smooth painted finish.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Installation drawings: Indicate configuration and dimensions of substrate(s) including (if applicable) penetrating and protruding elements; vinyl mural panels; seam locations; details of installation; and related and adjacent work. Note field-measured dimensions.
- B. Product Data:
 - 1. Manufacturers' specifications for vinyl film medium, inks and laminating film, and other data sufficient to demonstrate compliance with specified requirements
 - 2. Manufacturer's written preparation, installation, and cleaning and maintenance instructions and recommendations
- C. Samples:
 - 1. Color Approval Proof:
 - a. Full color laminated print produced with the same equipment that will be used for the actual vinyl wall graphics panels, using the specified resolution, ink sets, vinyl film printing medium and clear protective laminating film, in a size proportional to the finished mural, with the lesser dimension approximately equal to the width of the vinyl film medium.
 - b. Make adjustments, reprint and resubmit as necessary to obtain Architect's approval.
- D. Certificates: Submit written certification, on graphics provider firm's letterhead, that products and installation comply with specified requirements.

1.4 ENVIRONMENTAL CONDITIONS

- A. Maintain room and substrate temperature and humidity within the ranges recommended by the graphic film manufacturer at least 48 hours prior to, during, and after installation, until Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store products as recommended by the manufacturer(s), in graphics provider's labeled protective packaging. Protect from damage and deterioration.

1.6 WARRANTY

- A. Graphics provider shall provide a 10-year material and labor warranty against fading, edge lifting, peeling, discoloration, delamination of the overlaminate from the vinyl graphics film, and delamination of the vinyl film from the painted Level 5 skim-coated smooth-painted gypsum board substrate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS, MANUFACTURERS AND GRAPHICS PROVIDERS

- A. Specifications are based on products, manufacturers and graphics providers named herein or listed as the Basis of Design. Products of manufacturers listed which meet or exceed specifications are approved for use on the Project. Other manufacturers and graphics providers

must have a minimum of five (5) years experience supplying (and for graphics providers, installing) products meeting or exceeding the specifications, and comply with requirements of Section 01 25 13 Product Substitution Procedures to be considered.

2.2 GRAPHICS PROVIDER

- A. Basis of Design: Riot Creative Imaging division of ARC (Dana LaPointe), 6300 Gulfton, Houston, TX 77081; 713-830-3933; dana.lapointe@riotcolor.com; www.riotcolor.com
- B. Other Approved Manufacturer: Mountain Commercial Graphics; (713) 996-6634.
- C. Single-source Responsibility: Graphics Provider shall be solely responsible for processing, production and installation, whether installation is performed by its own personnel or by its approved installation contractor.

2.3 EQUIPMENT

- A. Basis of Design Printer: HP 3000 grand format inkjet printer with HP 881 Latex Printheads; 54 inch wide media capacity; 600 dpi minimum resolution, or equivalent equipment acceptable to the Architect and compatible with the specified (or approved substitution) inks and media.
- B. Laminator: Compatible with the specified (or approved substitution) vinyl film media, inks and overlamine.

2.4 MATERIALS

- A. Basis of Design for VWC-Drywall Application:
- B. Protective Laminated Film: ClearShield Wall Armor film. Category V Type II.
 - 1. Colorfastness: Greater than or equal to 200h.
 - 2. Washability: Greater than or equal to 100 cycles.
 - 3. Scrubbability: Greater than or equal to 300 cycles.
 - 4. Abrasion Resistance: Greater than or equal to 300 cycles.
 - 5. Cracking, Drying: Good.
 - 6. Stain Resistance to Reagents: 4.
 - 7. Flame Spread: Less than or equal to 25.
- C. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
 - 1. Curing: Heat and infrared cured
 - 2. VOCs: Less than 294 g/L
 - 3. Hazardous Air Pollutants (HAPs): None.
 - 4. Hazard Warning Labels: None (cautionary only; no "R" phrases).
 - 5. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C
- D. Vinyl Wall Covering: Dreamscape Suede.
 - 1. Description: Commercial grade vinyl printable vinyl wallcovering media for modern wide format inkjet printers.
 - 2. Construction: Embossed vinyl face with laminated fabric backing.
 - 3. Backing: Poly-cotton woven or polyester/pulp non-woven.
 - 4. Type Properties: Passes all criterion for WA 101, Type II.
 - 5. Thickness: 0.017 in.
- E. Accessory products, tools, and equipment: Recommended by, or acceptable to, the manufacturers of the materials with which they are used.
 - 1. Basis of Design for CMU Application:
- F. Vinyl Graphics Film: 3M™ "IJ180Cv3-10 Controltac™ Graphic Film" cast vinyl film suitable for inkjet printing. Calendered films are not acceptable.
 - 1. Film Thickness: 0.05 mm (2 mil, 0.002 inch)
 - 2. Surface: Smooth, white, opaque and glossy.

3. Applied shrinkage: < 0.1 mm per FTM 14.
4. Adhesive: Factory-applied 3M "Comply™ v3" solvent acrylic pressure-sensitive repositionable adhesive with air release channels, protected by double-sided polyethylene coated paper, for dry application only, for permanent, non-removable installation.
 - a. Adhesion: Approximately 18 N/25 mm per FTM 1 (180 degree peel, glass, 24h, 23 degrees C, 50 percent RH)
- G. Inks: HP™ 881 Latex Inks; low-VOC, UV-resistant, water-soluble, latex-based, odorless pigmented inks.
 1. Curing: Heat and infrared cured
 2. VOCs: Less than 294 g/L
 3. Hazardous Air Pollutants (HAPs): None.
 4. Hazard Warning Labels: None (cautionary only; no "R" phrases).
 5. Flammability/ combustibility: Nonflammable; noncombustible; FP > 93.3C
- H. Protective Laminating Film: 3M™ "Envision™ Luster Wrap Overlamine 8548L" cast film. Calendered films are not acceptable.
 1. Luster high performance non-PVC film
 2. Exceptional conformability and lifting resistance
 3. Less prone to scratching
 4. Superior UV and acid dew protection
 5. Longer term vertical durability
 6. Horizontal warranty

2.5 PROCESSING AND PRODUCTION

- A. Lay out each mural image in full-height vertical panels without horizontal seams. Allow overlap at vertical seams for accurate alignment and trimming. Unless otherwise specifically authorized by the Architect, lay out so panels are equal in width and arranged symmetrically. In no case shall a panel be less than one-half the vinyl media width.
- B. For uniform appearance, produce all panels using vinyl film media, inks, and laminating film that are each sourced from a single manufacturing lot or production run.
- C. Each panel shall be free from skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint as many panels as necessary for flawless appearance and consistent color match between all panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. With the installer, examine the conditions affecting work of this section, including but not necessarily limited to substrate surface smoothness, cleanliness, and uniformity; adjacent materials; and temperature and humidity.
 1. Confirm that substrate surfaces are properly finished, smooth, and clean, and are free of contaminants, texture, roughness, voids, protrusions and other surface irregularities that could impair adhesion or telegraph through the applied film.
 2. Report unsatisfactory conditions to the Architect in writing.
 3. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of installation shall be deemed to be acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Acclimatize printed vinyl film and other materials to the environment where they will be installed for at least 24 hours prior to commencement of installation, or for a longer period if recommended by the manufacturer.

- B. Prior to installation, re-inspect mural panels closely for skipped print head scan lines, ink deposition irregularities, physical defects and other noticeable flaws. If flaws are found, reprint and replace as many panels as necessary for flawless appearance and consistent color match between all panels.

3.3 INSTALLATION

- A. Digitally-Printed Vinyl Murals:
 - 1. Installation shall be performed only by trained, experienced personnel approved by the graphics provider.
 - 2. Install in accordance with manufacturer's instructions and reviewed submittals.
 - 3. Install in location(s) shown on drawings
 - 4. Seams: Hairline, with overlapped, razor-cut butt joints. Visually align adjacent panels for accurate registration with no visible gaps, offsets or misalignments.
 - 5. Install without bubbles, wrinkles, gaps, fish mouths and other surface and seam irregularities for a smooth, uniform appearance.

3.4 CLEANING AND PROTECTION

- A. Protect installed work from deterioration and other damage as recommended by the manufacturer until date of Substantial Completion.
- B. If necessary and possible, clean or repair murals to restore to like-new condition following manufacturer's written instructions and recommendations.
- C. Replace materials found to be defective or damaged, if it is not possible to clean or restore them to like-new condition.
- D. Clean and repair damaged adjacent surfaces and other work damaged by the work of this section. If damage cannot be cleaned or repaired to the equivalent of new condition (or for existing materials, their condition prior to damage from construction), replace damaged materials with new undamaged materials.

END OF SECTION 12 11 13

SECTION 12 24 00 - WINDOW SHADES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior manual roller shades.
 - 2. Accessories as required for complete installation.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.3 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- B. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute; Current Edition.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- E. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
- G. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb, and sill details, mounting dimension requirements for each product and condition, and operation direction.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

- F. Selection Samples: Include fabric samples in full range of available colors and patterns.
 - 1. Motorized Shades: Include finish selections for controls.
- G. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.
- H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
- J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- L. Maintenance contracts.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.
 - 1. Manufacturer's authorized representative.
 - 2. Factory training and demonstrated experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.8 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: One year.
 - 2. Fabric: One year.
 - 3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Interior Manually Operated Roller Shades:
 - a. Draper, Inc: www.draperinc.com.
 - b. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
 - c. Levolor: www.levolor.com/commercial.
 - d. Lutron Electronics Co., Inc: www.lutron.com.
 - e. MechoShade Systems LLC: www.mechoshade.com.

- f. Rollease Acmeda Contract: www.rolleaseacmedacontract.com.
 - g. TimberBlindMetroShade: www.timberblinds.com/commercial-division.
 - h. SWFcontract, a division of Springs Window Fashions, LLC.: www.swfcontract.com.
 - 2. Fabrics:
 - a. Lutron Electronics Co., Inc: www.lutron.com.
 - b. MechoShade Systems LLC: www.mechoshade.com.
 - c. Mermet Corporation: www.mermetusa.com.
 - d. Phifer, Inc: www.phifer.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.
- C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 ROLLER SHADES

- A. General:
 - 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Interior Shades:
 - 1. General Requirements:
 - a. Roll Direction: Roll down, closed position is at window sill, unless noted otherwise.
 - b. Mounting: As indicated on Drawings.
 - c. Roller Tubes:
 - 1) Material: Extruded aluminum.
 - 2) Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - 3) Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - 4) Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
 - d. Drop Position: Regular roll.
 - e. Double-Roller Drop Position:
 - 1) Light-Filtering Fabric: Room-side of opening.
 - 2) Room-Darkening Fabric: Glass-side of opening.
 - 2. Manually-Operated Shades:
 - a. Basis of Design:
 - 1) Mecho/5 System manufactured by MechoShade Systems, LLC.
 - b. Description: Manually operated fabric window shades for light-filtering, room-darkening, or both light-filtering and room-darkening as indicated on Drawings.
 - 3. Window Shade Fabrics:
 - a. SB1: Blackout Fabric.
 - 1) Basis of Design: Classic Blackout 0700 Series, Graphite 0717 as manufactured by Mechoshade.
 - b. SF1: Shade Fabric.
 - 1) Basis of Design: Soho 1600 Series; Silver Birch 1619 as manufactured by Mechoshade.

2.3 ROLLER SHADE FABRICATION

- A. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.5 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.
- C. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.
- D. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.7 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.8 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

- B. Provide to Owner, a proposal as an alternate to the base bid, a separate renewable maintenance contract for the service and maintenance of a motorized shade system for one year from date of Substantial Completion. Include a complete description of preventive maintenance, systematic examination, adjustment, parts and labor, cleaning, and testing, with a detailed schedule.

END OF SECTION 12 24 00

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SECTION 12 36 00 - COUNTERTOPS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Countertops for architectural cabinet work.
 - 2. Countertops for manufactured casework.
- B. Related Sections:
 - 1. Section 11 53 13 - Laboratory Fume Hoods: Work surfaces inside fume hoods.
 - 2. Section 12 35 53.19 - Wood Laboratory Casework: Laboratory countertops.
 - 3. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. AWI (QCP) - Quality Certification Program; Current Edition.
- H. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- I. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.
- J. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- K. IAPMO Z124 - Plastic Plumbing Fixtures; 2022.
- L. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- M. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- O. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- P. NSF 51 - Food Equipment Materials; 2023.
- Q. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
- R. PS 1 - Structural Plywood; 2023.
- S. SEFA 2 - Installations; 2010.
- T. SEFA 3 - Laboratory Work Surfaces; 2020.
- U. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- V. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.

W. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.4 PERFORMANCE REQUIREMENTS

- A. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
 - 1. All deadloads.
 - 2. 500 pound live load placed on the countertop and vanity.
 - 3. Deflection at Midspan: $L/1000$ times span or 1/8 inch (3 mm) whichever is less.
- B. WI Premium Grade: Where indicated on Drawings.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- H. Installer's qualification statement.
- I. Installation Instructions: Manufacturer's installation instructions and recommendations.
- J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - a. This AWI (QCP) project is registered as project number _____.
 - 2. Comply with AWMAC (GIS) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 3. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com.
 - 4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 5. Provide designated labels on shop drawings as required by certification program.
 - 6. Provide designated labels on installed products as required by certification program.

7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.8 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. Warranty the work specified herein for 5 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:
 1. Rough or difficult operation, or loose or missing parts.
 2. Delamination of surfaces.
 3. Noticeable deterioration of finish.
 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Manufacturers listed for products in this Section.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 COUNTERTOPS

- A. General:
 1. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 2. Quality Standard: SEFA 3 for laboratory worksurfaces.
- B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 1. Laminate Sheet: Refer to Section 06 20 00 - Finish Carpentry.
 2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch (32 mm) thick; covered with matching laminate.
 3. Back and End Splashes: Same material, same construction.
 4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.
 5. Fabricate in accordance with manufacturer's standard requirements.
- C. Epoxy Resin Countertops: Filled epoxy resin molded into homogenous, non-porous sheets; no surface coating and color and pattern consistent throughout thickness; with integral or adhesively seamed components.
 1. Basis of Design Products:
 - a. Products manufactured by Durcon, Inc.

- b. Products manufactured by Prime Industries, Inc.
 - 2. Flat Surface Thickness: 1 inch (25 mm), nominal.
 - 3. Chemical-Resistance: Provide products that resist the following chemicals with not more than Moderate Effect when tested in accordance with NEMA LD 3:
 - 4. Flammability: Self-extinguishing, when tested in accordance with ASTM D635.
 - 5. NSF approved for food contact.
 - 6. Surface Finish: Smooth, non-glare.
 - 7. Color: Black.
 - 8. Drip Edge: Drip groove 1/8 inch (3 mm) wide and deep, located 1/2 inch (12 mm) back from edge on underside of all exposed edges.
 - 9. Back and End Splashes: Same material, same thickness; separate for field attachment.
 - 10. Troughs: Same material; bottom sloped to outlet.
 - 11. Associated Reagent Shelves and Ledges: Same material.
 - a. Thickness: 3/4 inch (19 mm).
 - 12. Associated Window Stools: Same material.
 - a. Thickness: 3/4 inch (19 mm).
 - 13. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
 - 14. Fabricate in accordance with manufacturer's standard requirements.
- D. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
- 1. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Basis of Design Product:
 - 1) Products manufactured by Wilsonart.
 - b. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
 - c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - d. NSF approved for food contact.
 - e. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - f. Color and Pattern: Yukon Riverstone.
 - 2. Other Components Thickness: 1/2 inch (12 mm), minimum.
 - 3. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; square edge; use marine edge at sinks.
 - 4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
 - 5. Skirts: As indicated on Drawings.
 - 6. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
 - 7. Fabricate in accordance with manufacturer's standard requirements.
 - 8. All outside corners to be mitered.
 - 9. Locations: Admin Counters.
- E. Stainless Steel Countertops: Type 304, stainless steel sheet; 16 gauge, 0.0625 inch (1.59 mm) nominal sheet thickness.
- 1. Finish: 4B satin brushed finish.
 - 2. Back and End Splashes: Same material; welded 1/4 inch (6 mm) radius coved joint to countertop; square top edge with 1 inch (25 mm) wide top surface and minimum 1/2 inch (12 mm) turndown.

3. Splash Dimensions: 4 inch (100 mm) high by 1 inch (25 mm) thick, unless otherwise indicated.
4. Splash Height: 6 inch (150 mm).
5. Associated Reagent Shelves: Same material, with formed raised edges.
6. Associated Window Stools: Same material, same thickness.

2.3 MATERIALS

- A. Wood-Based Components:
 1. Wood fabricated from old growth timber is not permitted.
 2. Provide sustainably harvested wood, certified or labeled; refer to Section 01 60 00 - Product Requirements.
 3. Provide wood harvested within a 500 mile (805 km) radius of the project site.
 4. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- D. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- F. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch (12 mm) by 1/2 inch (12 mm).
 1. Color: As indicated on drawings.
 2. Color: As selected by the Architect from manufacturer's full line.
- G. Joint Sealant: Mildew-resistant silicone sealant, white.
- H. Polyester Protective Film: Scratch-, heat-, and acid-resistant optically clear removable polyester film for bonding to stone counters.
 1. Thickness: 4 mil, 0.004 inch (0.1 mm), minimum.
 2. Finish: Gloss.
 3. Construction: Multi-ply laminate.
 4. Adhesive Type: Pressure sensitive acrylic.
 5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
 6. NSF approved for food contact per NSF 51.
 7. Basis of Design Products:
 - a. Products manufactured by Stoneguard USA: www.stoneguardusa.com/#sle.
 - b. Products manufactured by Surface Shields, Inc.
 - c. TuffSkin manufactured by TuffSkin Surface Protection LLC.
- I. Sealer: Stain and acid protection for natural stone counters.
 1. NSF approved for food contact per NSF 51.
 2. Products:
 - a. Products manufactured by Custom Building Products.
 - b. Natural Finish Stone Sealer manufactured by Rockstar Sealing.
 - c. Products manufactured by STONETECH.

2.4 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.

1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash where indicated on Drawings.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches (102 mm), unless otherwise indicated.
- C. Stainless Steel: Fabricate tops up to 144 inches (3,657 mm) long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
1. Weld joints; grind smooth and polish to match.
 2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
 3. Provide wall clips for support of back/end splash turndowns.
 4. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.
 5. Integral sinks: Fabricate with corners rounded and coved, double-walls for sink compartment partitions, and drainboards. Factory-punch holes for fittings, and weld sinks to countertops.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install vanities in accordance with manufacturer's instructions and approved shop drawings
- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- D. Attach stainless steel countertops using stainless steel fasteners and clips.
- E. Attach epoxy resin countertops using compatible adhesive.
- F. Seal joint between back/end splashes and vertical surfaces.
 1. Where indicated use rubber cove molding.
 2. Where applied cove molding is not indicated use specified sealant.

3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.5 CLEANING

- A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 12 36 00

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SECTION 12 66 13 - TELESCOPING BLEACHERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Telescoping bleachers.
- B. Electric motor operators, controls, and internal wiring.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections: Connection of electric motors and controls.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- E. NFPA 102 - Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures; 2021.
- F. PS 1 - Structural Plywood; 2023.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage handling and requirements.
 - 3. Installation methods.
- C. Shop Drawings: Complete layout with dimensions, seat heights, row spacing and rise, aisle widths and locations, points of connection to substrate, assembly dimensions, and material types and finishes.
 - 1. Provide drawings customized to this project.
 - 2. Include Professional Engineer certification.
- D. Selection Samples: For each material for which color selection is required, submit samples, 2 by 2 inches (50 by 50 mm) in size, illustrating colors and finishes available.
- E. Verification Samples: For each custom colored finish, submit samples of actual finish or product, for verification of color selection.
- F. Operation and Maintenance Data: Manufacturer's operation and maintenance instructions, including annual inspection and maintenance and bi-annual inspection by a Professional Engineer or manufacturer factory service personnel.
- G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Manufacturer's installation crew.

- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M, AWS D1.3/D1.3M, and no more than 12 months before the start of scheduled welding work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store, in original packaging, under cover and elevated above grade.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion. Replace parts that fail under normal use at no extra charge to Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Telescoping Bleachers:
 - 1. Interkal LLC: www.interkal.com/#sle.
 - 2. Irwin Telescopic Seating Company: www.irwintelescopicseating.com/#sle.
 - 3. Hussey Seating Company: www.husseyseating.com/#sle.

2.2 TELESCOPING BLEACHERS

- A. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.
 - 1. Basis of Design: MAXAM as manufactured by Hussey.
 - 2. Provide a design certified by a licensed Professional Engineer.
 - 3. Design to comply with applicable requirements of NFPA 102 and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
 - 4. Design with solid fascia (riser) or seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
 - 5. Configurations: As indicated on drawings.
 - 6. Wheelchair Spaces: Permanent open spaces at locations indicated on drawings in compliance with ADA Standards.
 - 7. Operation: Some manual and some motor operated.
- B. Design Loads: Design to withstand the following loading conditions:
 - 1. Live Load on Structural Supports: 100 psf (4.8 kPa), minimum, of gross horizontal projection.
 - 2. Live Load on Seats and Walking Surfaces: 120 pounds per linear foot (1750 N/m).
 - 3. Lateral Sway Stress on Structural Supports: 24 pounds per linear foot (350 N/m) of seat plank.
 - 4. Perpendicular Sway Stress on Structural Supports: 10 pounds per linear foot (146 N/m) of seat plank.
- C. Dimensions:
 - 1. See drawings for overall dimensions.
 - 2. Rows: Refer to Drawings.
 - 3. Rise Per Row: 10 inches (254 mm).
 - 4. Row Depth: 22 inches (589 mm).
 - 5. Seat Height Above Tread: 6 inches (150 mm).
- D. Structural Supports: Steel or aluminum; manufacturer's standard wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.

1. Design so that each row carriage so that it will individually support the design loads and is self supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
 2. Welding: In accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
 3. Bolting: Use lock-washers or locknuts.
 4. Wheels: Minimum 5 inch (125 mm) diameter by 1-1/8 inch (28 mm) wide, with non-marring rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
 5. Finish: Manufacturer's standard enamel or powder coating.
 6. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
 7. Unlocking (Manual): Provide single manual release mechanism to allow retraction of all carriages, concealed behind skirt board of first row. Must be compatible with AssaAbloy's SFIC Cores.
 8. Unlocking (Motor): Automatically unlock all rows before engaging retraction mechanism. Must be compatible with AssaAbloy's SFIC Cores.
- E. Motor Operation: Manufacturer's standard drive mechanism, using motor adequately sized for the purpose.
1. Provide UL listed electrical components and wiring.
 2. Controls: Start, Stop, Forward, and Reverse in a single control unit.
 3. Key Operation: Operating mechanism to be compatible with AssaAbloy SFIC Cores.
 4. Control Station : Removable plug-in low-voltage pendant station, with first-row plug-in location for each motor.
 5. Limit Switches: Automatically stop operation when unit has reached fully open or fully closed position.
 6. Provide all wiring internal to bleacher units, to junction box located where indicated; ensure that wiring is not energized except during operation.
 7. Electrical Characteristics: 120V, single phase, 60 Hz.
 8. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least 30 inches (760 mm) wide is acceptable.

2.3 SEAT AND PLATFORM COMPONENTS

- A. Seat/Fascia Assembly: Continuous, molded UV-stabilized high-density polyethylene plastic, seat minimum 1 inch (25 mm) thick, textured finish, homogeneous color throughout, color as selected from manufacturer's standard selection; approximately 18 inch (460 mm) long sections independently removable with tongue-and-groove or rabbeted interlock at end joints.
1. Shape: Ergonomically contoured, with internal ribs spaced for natural flexibility; rear edge cantilevered to provide toe room of not less than 3 inches (75 mm); no openings to trap debris.
 2. Provide end caps of same material and finish on each exposed end.
 3. Supports: Internal steel reinforcement of each seat segment bolted to platform nose member; minimum two bolts per segment.
- B. Platform, Tread, and Step Structure: Plywood continuously supported on front and rear with side joints tongue-and-grooved.
1. Plywood: PS 1, 5-ply southern pine or polyethylene-overlaid douglas fir or southern pine, Grade A-C.
 2. Plywood Thickness: 5/8 inch (16 mm), minimum.
 3. Front (Nose), Rear, and Intermediate Supports: Steel channel or tube, hot-dipped galvanized.
 4. Provide end caps of same material and finish on each exposed end.

2.4 HANDRAILS AND RAILINGS

- A. Provide the following railings:
 - 1. Aisle Handrails: Single post folding railing segment mounted in center of aisle at every other row beginning at row 2.
 - 2. Center Aisle Handrails: Auto-Rotating.
 - 3. End of Row Guardrails: Self-storing, at open ends of sections beginning at row 2.
 - 4. Top Row Rear Guardrail: Non-removable self-storing, mounted behind rear seat with tubular supports, running full width of section.
 - 5. Height: 42 inches (1067 mm) above adjacent platform or tread.
- B. Design handrails and railings to withstand the following loads:
 - 1. Concentrated Load on Handrails: 200 pounds (890 N) in any direction.
 - 2. Concentrated Load on Guardrails: 200 pounds (890 N) in any direction along top rail.
 - 3. Live Load on Handrails: 50 pounds per linear foot (790 N/m), applied in any direction.
 - 4. Live Load on Guardrails:
 - a. Horizontal: 50 pounds per linear foot (790 N/m), applied at the guardrail height.
 - b. Vertical: 100 pounds per linear foot (1460 N/m), applied vertically to top of guardrail.
- C. Railing Construction: Round steel or aluminum pipe or tube, with formed elbows at corners and caps at ends of straight runs.
 - 1. Aluminum: 1.66 inches (42 mm) minimum outside diameter; natural anodized finish.
 - 2. Steel: 1-1/2 inch (38 mm) minimum outside diameter, with 11 gauge, 0.12 inch (3.05 mm) minimum wall thickness; textured powder coat epoxy finish.

2.5 ACCESSORIES

- A. Fillers and Closures:
 - 1. Ends of Retracted Units: Vinyl curtain.
 - 2. Vinyl Curtains: 18 ounce (510 g) vinyl with grommets; color as selected from manufacturer's standard palette.
- B. Motion Monitor: Strobe light and warning horn rated at 150 dB, both of which operate continuously during movement of any section of bleachers; mount strobe light where it is clearly visible to entire bleacher installation.
- C. Fasteners: Provide hardware and fasteners in accordance with manufacturer's recommendations.
- D. Anchorage: As indicated on drawings; provide hardware in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are consistent with those on the shop drawings.
- B. Do not begin installation until substrates have been properly prepared and area has been cleared of obstructions.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Do not field cut or alter seats, fascia, or structural members without approval.
- C. Provide manufacturer's field representative to inspect completed installation.

3.4 ADJUSTING

- A. Lubricate, test, and adjust each moving assembly to ensure proper operation in compliance with manufacturer's recommendations.

3.5 CLEANING

- A. Clean exposed and semi-exposed assembly surfaces.
- B. Touch up finishes on damaged or soiled areas.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstration and Training: Provide manufacturer's field representative to demonstrate to and train Owner's operating personnel in proper operation of equipment.
 - 1. Location: On site using installed equipment.
 - 2. Time: As agreed between Owner and Contractor.

3.7 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 12 66 13

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SECTION 13 19 13 - KENNEL ENCLOSURES AND GATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Kennel cages, tubs, and accessories for complete installation.
- B. Canine Waste Station.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - a. Manufacturer's installation instructions.
 - b. Manufacturer's operation and maintenance data, as applicable.
- B. Shop Drawings: Show sizes, locations and installation details.

1.4 WARRANTY

- A. Standard: Warrant Work for three (3) years from defects.

PART 2 PRODUCTS

2.1 MANUFACTURERS GENERAL

- A. Specifications are based on named products and manufacturers. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 KENNEL CAGES

- A. Owner Furnished, Owner Installed.

2.3 STAINLESS TUB

- A. Manufacturers:
 - 1. Master Equipment.
- B. Basis of Design: Model TP382 as manufactured by Master Equipment.
- C. Materials:
 - 1. Tub Basin: Type 304, stainless steel, 14 gauge, 2 mm thick.
 - 2. Backsplash: Type 304, stainless steel, 14 gauge, 2 mm thick.
 - 3. Tub Legs: Type 304, stainless steel, 19 gauge, 1 mm thick. Leg levelers are black rubber.
 - 4. Grooming Bar: Type 304, stainless steel, 9 gauge, 4 mm thick.
 - 5. Tub Racks: Grates are white polyethylene, 4 mm thick. Frame is type 30, stainless steel, 19 gauge, 1.1 mm thick.
 - 6. Tub Ramp: Type 304, stainless steel, 19 gauge, 1 mm thick. Feet are black rubber.
 - 7. Tub Drain: Type 304, stainless steel.
 - 8. Drain Basket: Type 304, stainless steel, 26 gauge, 0.5 mm thick.
 - 9. Drain Cover: Type 304, stainless steel, 20 gauge, 1 mm thick.
 - 10. Waterproof Ring: Black polyurethane. Slip nut is polyethylene.
 - 11. Drain Hose: Hose length is 6-3/4 inch, outside diameter is 1-3/4 inch, and inside diameter is 1-1/2 inch. Hose is black polypropylene. Clamp is aluminum.
- D. Drain & Plumbing:

1. Drain: 3-1/4 inch predrilled drain hole. Center of drain from front wall 12-1/2 inch, center of drain from back of wall 12-1/2 inch, center of drain from side wall 11 inch.

2.4 WASTE STATION

- A. Canine Waste Station:
 1. Basis of Design: Model 135-1003 as manufactured by The Park Catalog.
 2. Material: Powder Coated Aluminum.
 3. Color: Green.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify items fastened to walls have proper blocking or support items installed.
- B. Verify locations for items are ready for their installation.

3.2 INSTALLATION

- A. Install all items in accordance with manufacturer's printed instructions in locations shown on drawings or otherwise indicated.

3.3 CLEANING AND ADJUSTING

- A. Make final adjustment after installation and clean all substances which may affect final finish.
- B. Clean all items of dirt and foreign matter which may affect appearance and operation.
- C. Adjust items for proper operation.
- D. Instruct Owner's personnel on proper operation and maintenance of items.

SECTION 13 34 19 - METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Manufacturer-engineered, shop-fabricated structural steel building frame.
 - 2. Insulated Metal wall and roof panels including soffits, gutters and downspouts, and roof mounted equipment curbs.
 - 3. Exterior windows.
 - 4. Skylights.
 - 5. Exterior overhead doors and frames.
 - 6. Ventilators.
 - 7. Louvers.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 07 92 00 - Joint Sealants: Sealing joints between accessory components and wall system.
 - 3. Section 08 11 13 - Hollow Metal Doors and Frames.
 - 4. Section 08 13 16 - Aluminum Doors.
 - 5. Section 08 33 23 - Overhead Coiling Doors.
 - 6. Section 08 36 13 - Sectional Doors.
 - 7. Section 08 51 13 - Aluminum Windows.
 - 8. Section 08 62 00 - Unit Skylights.
 - 9. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2023).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- H. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality; 2019.
- I. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel; 2021, with Editorial Revision.
- J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

- K. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2023.
- L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.
- M. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- N. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures; 2016.
- O. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- P. ASTM C991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings; 2023.
- Q. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- S. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- T. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- U. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- W. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- X. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- Y. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2024.
- Z. MBMA (MBSM) - Metal Building Systems Manual; 2024.
- AA. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- BB. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on profiles, component dimensions, fasteners.
- C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and foundation loads; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
- D. Samples: Submit two samples of precoated metal panels for each color selected, 4 inches by 4 inches in size illustrating color and texture of finish.

- E. Manufacturer's Instructions: Indicate preparation requirements, anchor bolt placement.
- F. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
- G. Designer's Qualification Statement.
- H. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under IAS AC472.
 - 1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically designed to support and transfer loads and properly assembled components form a complete or partial building shell.
- I. Erector's Qualification Statement.
- J. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- K. Project Record Documents: Record actual locations of concealed components and utilities.

1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.
 - 1. Design Engineer Qualifications: Licensed in the State in which the Project is located.
 - 2. Comply with applicable code for submission of design calculations as required for acquiring permits.
 - 3. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.
- B. Perform work in accordance with AISC 360 and MBMA (MBSM).
 - 1. Maintain one copy on site.
- C. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Not less than three years of documented experience.
 - 2. Accredited by IAS in accordance with IAS AC472.
- D. Erector Qualifications: Company specializing in performing the work of this section approved by manufacturer.
- E. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking, or fading. Include coverage for weather tightness of building enclosure elements after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. Butler Manufacturing Company: www.buttermfg.com/#sle.
2. Ceco Building Systems: www.cecobuildings.com/#sle.
3. Chief Buildings: www.chiefbuildings.com/#sle.
4. Kirby Building Systems: www.kirbybuildingsystems.com/#sle.
5. Metallic Building Systems: www.metallic.com/#sle.
6. Mueller, Inc.: www.muellerinc.com/#sle.
7. Nucor Building Systems: www.nucorbuildingsystems.com/#sle.
8. VP Buildings: www.vp.com/#sle.

- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 ASSEMBLIES

- A. Frames: As indicated on Drawings.
- B. Bay Spacing: As indicated on Drawings.
- C. Primary Framing: Rigid frame of rafter beams and columns, canopy beams, and wind bracing.
- D. Secondary Framing: Purlins, and other items detailed.
- E. Wall System: Preformed metal panels of horizontal profile, with sub-girt framing/anchorage assembly, and accessory components.
- F. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly, insulation, and liner panels, and accessory components.
- G. Roof Slope: 1/8 inches in 12 inches (1/100).

2.3 PERFORMANCE REQUIREMENTS

- A. Installed Thermal Resistance of Wall System: R-Value of 19.
- B. Installed Thermal Resistance of Roof System: R-Value of 30.
- C. Design structural members to withstand dead load, and design loads due to pressure and suction of wind calculated in accordance with applicable code.
- D. Design structural members to withstand live loads and wind loads as indicated in the Structural Drawings.
- E. Design structural members to withstand Class 30 wind uplift in accordance with UL 580.
- F. Exterior wall and roof system shall withstand imposed loads with maximum allowable deflection of 1/90 of span.
- G. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
- H. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to average temperature ranges for the local area.
- I. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

2.4 MATERIALS - FRAMING

- A. Structural Steel Members: ASTM A36/A36M.
- B. Structural Tubing: ASTM A500/A500M Grade B cold-formed.
- C. Plate or Bar Stock: ASTM A529/A529M, Grade 50.
- D. Anchor Bolts: ASTM A307, Grade A, with no preference for protective coatings.
- E. Anchor Bolts: ASTM F1554, Grade 36, Class 1A, with no preference for protective coating.
- F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1; galvanized to ASTM A153/A153M.

- G. Welding Materials: Perform in accordance with AWS D1.1/D1.1M.
- H. Primer: SSPC-Paint 20 zinc rich. Color: Gray.
- I. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch (48 MPa).
 - 3. Height Change, Plastic State: When tested in accordance with ASTM C827/C827M:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.

2.5 MATERIALS - WALLS AND ROOF

- A. Manufacturer Standard Walls and Roof:
 - 1. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.
 - 2. Steel Sheet: ASTM A792/A792M aluminum-zinc alloy coated to AZ50/AZM150.
 - 3. Insulation: Semi-rigid glass fiber type, unfaced, ASTM E84 Class A, flame spread index of 25 or less where exposed, friction fit, 8 inches thick.
 - 4. Insulation: ASTM C665 Type I; 8 inches thick.
 - a. Facing: Sheet vinyl, 3/8 inch thick, white.
 - 5. Metal Building Type, Factor Applied, Vapor-Barrier Insulation Facings: Water vapor permeance no greater than 0.10 perm (5.7 ng/(Pa s sq m)) when tested in accordance with ASTM E96/E96M; flame spread index of 25 or less, and smoke developed index of 40 or less when tested in accordance with ASTM E84.
 - a. Manufacturers:
 - 1) Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 6. Joint Seal Gaskets: Manufacturer's standard type.
 - 7. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.
 - 8. Bituminous Paint: Asphaltic type.
 - 9. Sealant: Manufacturer's standard type.
 - 10. Sealant: ASTM C920, elastomeric sealant with movement capability of at least plus/minus 50 percent; 100 percent silicone; for exposed applications, match adjacent colors as closely as possible.
 - 11. Metal Mesh: Galvanized steel wire, woven.
 - 12. Roof Curbs: Insulated metal same as roofing, 24 gauge thick, designed for imposed equipment loads, anchor fasteners to equipment, counterflashed to metal roof system.
 - 13. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Rain Water Diverter, Fascias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

- B. Refer to Section _____.

2.6 COMPONENTS

- A. Doors and Frames: Manufacturer's standard.
- B. Aluminum Doors: Refer to Section 08 13 16 - Aluminum Doors.
- C. Hollow Metal Door: Refer to Section 08 11 13 - Hollow Metal Doors and Frames.
- D. Overhead Doors and Frames: Manufacturer's standard.

1. Glass and Glazing: Refer to Section 08 80 00 - Glazing.
- E. Overhead Coiling Doors: Refer to Section 08 33 23 - Overhead Coiling Doors.
- F. Sectional Doors: Refer to Section 08 36 13 - Sectional Doors.
- G. Overhead Door Frame: Formed steel sections braced to building frame specified in Section 05 50 00 - Metal Fabrications.
- H. Windows: Manufacturer's standard.
 1. Glass and Glazing: Refer to Section 08 80 00 - Glazing.
- I. Aluminum Windows: Refer to 08 51 13 - Aluminum Windows.
- J. Unit Skylight: Refer to Section 08 62 00 - Unit Skylight.
- K. Ventilators: Sheet steel, galvanized, rotary design size and spacing as indicated. Furnish with matching base, bird screen, hood flashing, closures, and fittings. Finish to match roof panels.
- L. Wall Louvers: 18 Gauge type Z blade design, same finish as adjacent material, with 1/2 inch by 1/2 inch galvanized steel mesh bird screen and frame, blank sheet metal at unused portions.

2.7 FABRICATION - FRAMING

- A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
- B. Anchor Bolts: Formed with bent shank, assembled with template for casting into concrete.
- C. Provide framing for skylight openings.
- D. Provide wall opening framing for doors, windows, and other accessory components.

2.8 FABRICATION - WALL AND ROOF PANELS

- A. Siding: Minimum 22 gauge metal thickness, 12 profile indicated, 1-1/2 inch deep, lapped edges fitted with continuous gaskets.
- B. Siding: Refer to Section 07 42 13 - Metal Wall Panels.
- C. Roofing: Minimum 24 gauge 2 inch high by 3/4 inch wide rib by 16 inch wide, striated concealed fastener panel.
 1. Metal Roof System: Vertical leg, concealed fastener, standing seam, utilizing male and female rib configurations, with factory applied hot-melt mastic in female rib, continuously locked together by an electrically powered mechanical seaming device during installation.
 2. Gauge: Minimum 24 gauge (UL 90 rated).
 3. Substrate: Galvalume steel sheet, Grade "D" minimum yield of 50,000 PSI.
 4. Clips: Two (2) piece floating clip, 18 gauge base, 24 gauge top, with factory applied mastic, with two (2) fasteners to structural. Comply with FM 1-90 requirements.
 5. Texture: Striations.
 6. Finish: Premium fluorocarbon coating produced with Kynar 500 (20 year warranty) in color selected by Architect from Manufacturer's available colors.
 7. Touch-up Paint: ZRC Cold Galvanizing Compound manufactured by ZRC Chemical Products, Quincy, MA; Galvax Zinc-Rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawrence, MA; or paint complying with military specification MILP-21035A, Type I or III.
 8. Approved Product/ Manufacturer: Superlock Architectural Structural (Double-Lock) standing seam metal roof system manufactured by MBCI, Houston, TX; (281) 445-8555, or Architect approved equal.
- D. Liner: Minimum ____ inch (____ mm) metal thickness, flat profile indicated, lapped V edges fitted with continuous gaskets.
- E. Soffit Panels: Minimum 22 metal thickness, flat profile indicated, perforated for ventilation.
- F. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.

- G. Internal and External Corners: Same material thickness and finish as adjacent material, profile shop-formed to required angles. Back brace mitered internal corners with ____ inch (____ mm) thick sheet.
- H. Expansion Joints: Same material and finish as adjacent material where exposed, manufacturer's standard shop-formed sheet metal type, of profile to suit system.
- I. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.
- J. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts and scuppers of rectangular profile and size indicated to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

- A. Framing Members: Clean, prepare, and shop prime. Do not prime surfaces to be field welded.
- B. Exterior Surfaces of Wall Components and Accessories: Kynar 500 finish, color as selected from manufacturer's standard range.
- C. Interior Surfaces of Wall Components and Accessories: Kynar 500 finish, color as selected from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position

3.2 ERECTION - FRAMING

- A. Erect framing in accordance with AISC 360.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- C. Set column base plates with non-shrink grout to achieve full plate bearing.
- D. Do not field cut or alter structural members without approval.
- E. After erection, prime welds, abrasions, and surfaces not shop primed.

3.3 ERECTION - WALL AND ROOF PANELS

- A. Install in accordance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End laps minimum 2 inches (50 mm). Place side laps over bearing.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners.

- G. Install insulation and vapor retarder utilizing for attachment. Place wire mesh under vapor retarder for support between framing members.
- H. Install sealant and gaskets, providing weather tight installation.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

- A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Apply bituminous paint on surfaces in contact with cementitious materials.
- C. Slope gutters as required for positive drainage.
- D. Connect downspouts to storm sewer system.
- E. Install splash pans under each downspout.

3.5 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

- A. Install door frames, doors, overhead doors, and windows and glass in accordance with manufacturer's instructions.

3.6 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from level; 1/8 inch (3 mm) from plumb.
- B. Siding and Roofing: 1/8 inch (3 mm) from true position.

END OF SECTION 13 34 19

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- D. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational.
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

- A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.

- B. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- C. All materials and distribution, and utilization equipment shall be UL Listed.
- D. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner

1.4 QUALIFICATION OF CONTRACTORS

- A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.
- B. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas
 - 3. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.5 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
 - 1. The International Fire Prevention Code
 - 2. The International Building Code
 - 3. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 101 - Life Safety Code
 - b. NFPA 13 - Installation of Sprinkler Systems
 - c. NFPA 14 - Installation of Standpipe and Hose Systems
 - d. NFPA 20 - Installation of Centrifugal Fire Pumps
 - e. NFPA 24 - Installation of Private Fire Service Mains
 - f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
 - g. NFPA-2001 – Standard for Clean Agent Fire Extinguishing Systems
- B. Factory Mutual (FM) Approval Guide
- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

1.6 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.7 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation of a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.
- E. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Access Panels
 - 2. Floor, Wall, and Ceiling Plates
 - 3. Insulation
 - 4. Heattrace
 - 5. Piping and Equipment Identification
 - 6. Painting

1.8 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.

- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.9 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.

- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.10 ORDINANCES, PERMITS AND DRAWING APPROVALS

- A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.
- B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.
- C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.11 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
 - 1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 - 2. Samples, where applicable or requested.
 - 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 - 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 - 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 - 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 - 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 - 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution

- F. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.12 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.

- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.13 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.14 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.15 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
 1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
 1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer

- for review. All labor and materials required to perform the work described shall be part of this Contract.
2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
 3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
 4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
 5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
 6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
 7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
 8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
 9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
 10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
 11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
 12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.

13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.16 EQUIPMENT, MATERIALS, BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.17 PRECONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.18 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.19 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.20 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
 - 1. Facilities with less than 300 sprinklers – 6 minimum
 - 2. Facilities with 300 to 1000 sprinklers – 12 minimum
 - 3. Facilities with over 1000 sprinklers – 24 minimum

1.21 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
 - 1. Number of Copies: Submit one set of marked up record prints.
 - 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- D. As-Built drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents
 - 2. Remove Engineer's seal, name, address and logo from drawings.
 - 3. Mark documents AS-BUILT DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY.

5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
6. Indicate exact location of all underground plumbing and flow line elevations.
7. Indicate exact location of all underground mechanical piping and elevations.
8. Indicate exact location of all underground electrical raceways and elevations.
9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

1.22 START-UP-SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.23 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders. These manuals shall each contain the following:
 1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
 2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
 3. Provide a competent manufacturer's service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer's service engineer and witnessed by the Owner's representative and shall be included in the as-built submittal.
 4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
 5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All sprinkler system equipment is to be UL Listed or FM Approved.

2.2 ACCESS PANELS

- A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.
- B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- C. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.
- D. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.4 GALVANIC PROTECTION

- A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings

2.5 INSULATION

- A. The following shall be insulated:
 - 1. All fire suppression water piping above grade (outdoor).
 - 2. All fire suppression water piping above grade (un-condition space).
 - 3. Acceptable manufacturers:
 - a. Manville Corporation.
 - b. Certain-Teed.
 - c. Owens Corning Fiberglass.
 - d. Knauf Insulation.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber, Glass fibers bonded with a thermosetting resin complying with the following:
 - 1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.
 - 2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
 - 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades
 - a. Class I, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - c. Class 2, Grade A, and comply with MIL-A-3316C. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 - 6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 - 7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
 - 1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class I.
 - 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- G. Field-Applied Jackets:
 - 1. General: ASTM C 921, Type I, unless otherwise indicated.
 - 2. Foil and Paper Jacket: Not acceptable.
 - 3. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - a. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. PVC Jacket Color: White.
 - c. PVC Jacket Color: Color-code piping jacket as determined by existing conditions.
 - d. Not to be used for outdoors.
 - 4. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil (0.75 mm) thick, high-impact, ultraviolet-resistant PVC.
 - a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - b. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or

- less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Not to be used for outdoors.
 - 5. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
 - a. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick.
 - b. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
 - c. Elbows: preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket.
 - 6. Joint Sealants: For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Accessories and Attachments
- 1. Bands: stainless steel ASTM A666, Type 304, 3/4 inch (20 mm) wide; 0.02 inch (0.050 mm) thick.
- I. Vapor Retardants
- 1. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.6 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Provide a complete UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.
- D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.
- E. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- F. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- G. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.

- H. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- I. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot.
- J. All piping shall be insulated with 1" thick fiberglass insulation.
- K. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- L. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.7 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:
 - 1. All above ground fire protection standpipe and sprinkler piping
 - 2. All above ground sprinkler drainage piping
- B. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
 - 1. Sprinkler piping
 - 2. Dry Sprinkler piping
 - 3. Drain piping
 - 4. Pre-Action piping
 - 5. Clean Agent piping
 - 6. FDC piping
- C. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.
- D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.
- E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- F. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.
- G. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems. All valves on pumps shall be similar to the valve tags specified

above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.

- H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.8 EQUIPMENT LABELING

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.
- B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
 - 1. Permanently attached plastic laminate signs with 1" high lettering.
 - 2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.9 PAINTING

- A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior or moisture conditions such as piping in parking decks, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.
- B. All piping exposed to corrosive environment such as pool areas, pool equipment room, sanitization room, and acid room shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect
- C. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.

- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.
- G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- I. Provide a pressure gauge at the top level of all standpipes.
- J. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- K. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- L. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- M. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.
- N. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- O. Building shall be 100 percent fully sprinklered.
- P. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- Q. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.

- R. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- S. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- T. Provide protection in all gymnasium areas.
- U. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 PREPARATION

- A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

3.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.

- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.
- H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.
- L. Supply piping (domestic and /or fire water) shall not pass under footings or through grade beams unless noted otherwise.

3.5 CLEANING

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.
- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.6 DEMONSTRATION

- A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.
- B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.
- C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner's representative. Testing should be coordinated with the Authority Having Jurisdiction.

- D. Provide the Owner with as-built drawings and equipment data at completion of construction. As-built drawings shall include an overall graphic drawing of areas covered by each sprinkler zone. This is to include auxiliary drains and inspector test locations. This is to be updated and displayed at riser room. New graphic to include existing systems.
- E. Complete set of as-built drawings (Per NFPA) to be provided to document box at FACP. Drawings to include hydraulic calculation plate information. As-built to be provided in cad and PDF formats to district.
- F. Zone calculation plates to be permeant type (metal or laminate) with printed information attached to each riser.
- G. Provide completed Underground and Aboveground Contractor's material and Test Certificates per NFPA 13 at time of acceptance of test.
- H. Inspections test to be piped into nearest drain to support flow.

3.7 PAINTING

- A. Where exposed in any MEP equipment room, all fire protection piping shall be painted red.
- B. Paint prior to the installation of sprinkler heads; replace any sprinkler heads that come in contact with paint with new heads.

3.8 WORKMANSHIP

- A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.
- B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.
- C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.
- D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.
- E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.9 ERECTION AND INSTALLATION

- A. Installation and workmanship requirements are specified hereinafter.

- B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

3.10 TESTS

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the "Contractor's Materials and Test Certificate" shall be submitted to the Architect.
- B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- E. Prior to final acceptance by the Owner, submit the "Contractor's Material and Test Certificates" indicating system compliance with all applicable sections of NFPA.

3.11 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
 - 1. Minimum of 8 hours dedicated instructor time.
 - 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated

- system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
 - I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
 - J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
 - K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operation and Maintenance Manual”:

3.12 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
 - 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten
 - 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 - 4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
 - 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual
 - 6. Binder as specified.
- B. Content of Manual:
 - 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 - 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).

3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 4. Provide complete information for products specified in Division 23.
 5. Provide certificates of compliance as specified in each related section.
 6. Provide start up reports as specified in each related section.

7. Provide signed receipts for spare parts and material.
8. Provide training report and certificates.
9. Provide backflow preventer certified test reports.

END OF SECTION 21 05 00

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- D. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 DESCRIPTION

- A. This section describes the following:
 - 1. Hangers, supports and anchors for the fire protection equipment, tanks and piping systems.
 - 2. Supplementary steel for support or attachment of fire protection tanks, equipment and piping to general construction elements of the project.

1.3 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. Code of Federal Regulations 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA-13 Installation of Sprinkler Systems.
 - 2. NFPA-14 Installation of Standpipe and Hose Systems.
- D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA):
 - 1. Seismic Restraint Manual: Guidelines for Mechanical Systems - latest edition for the support of ductwork.
- E. UL Fire Resistance Directory, latest edition.

1.4 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

- B. Section Includes:
 - 1. Pipe, duct, and equipment hangers and supports.
 - 2. Anchors, equipment bases and supports.
 - 3. Sleeves and seals.
 - 4. Flashing, counter flashing and pipe stacks.
 - 5. Firestopping.

1.5 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Submit calculations showing compliance with Division 01 Section "Lateral Force Procedures" for seismic bracing of ductwork and piping.

1.7 QUALITY ASSURANCE

- A. Comply with Division 21 Section "Common Results for Fire Suppression."
- B. Supports for Sprinkler Piping: Comply with NFPA 13.
- C. Supports for Standpipes: Comply with NFPA 14.
- D. Do not use black steel devices, components, fasteners, etc. within the Clean Room interstitial space or in any related air flow path. Steel items shall be plated, galvanized, painted, or coated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. B-Line Systems.
 - 3. Grinnell.
 - 4. Superstrut,
 - 5. Anvil.
- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal. Use plastic coated hangers at all uninsulated copper piping.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, black or galvanized, adjustable, clevis, UL listed, Grinnell Fig. 260 or equal.
 - 4. Multiple or Trapeze Hangers: 12 gauge (2.67 mm) channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps. Furnish cushion strip on all uninsulated copper piping and; cast iron roll and stand for hot pipe sizes 6 inches and over.
 - 5. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12 gauge channel complete with pipe clamps, nuts, bolts, and end caps. Furnish cushion strip on all uninsulated copper piping and adjustable steel yoke and cast iron roll for hot-pipe sizes 6 inches and over.
 - 6. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.
 - 7. Floor Support for Pipe Sizes to 4 Inches (101.6 mm) and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
 - 8. Floor Support for Hot Pipe Sizes 6 Inches (152.4 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support
 - 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 - 10. CPVC Tube Support: CTS sized hangers or supports free of sharp edges.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 ATTACHMENT TO STRUCTURE

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. Connection to Existing Concrete Structure: Concrete anchors conforming to Division 03 Section "Concrete Accessories".
- C. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert.
- D. For Support on New Concrete: Galvanized steel headed bolts.
- E. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment.
- F. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load.

2.4 SUPORTS, BRACING, AND ACCESSORIES

- A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize all steel parts after fabrication where used outdoors or inside the penthouse.
- B. Fasteners: All bolts and nuts, except as otherwise specified, shall conform to ASTM Standard Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. All bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and all galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. All ferrous metal components below grade shall be stainless steel.
- C. Sheet Metal Screws: Plated, size 10 minimum.
- D. Pre-engineered duct and pipe bracing systems may be Mason Industries Seismic Sway Brace System or equal.

2.5 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel.
- B. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Provide stainless steel sheet metal for exterior walls.
- C. Sealant: Acrylic

2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.8 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.9 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.
- B. **Beam clamps shall only be used on beams. It is acceptable to use clamps on the top cord of the joist within 3" of the panel point but never on the bottom cord of the joist at any location. It is also acceptable to route a vertical all-thread thru the middle of the joist.**
- C. Supports for Gas Piping:

1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- N. Support PEX tubing every 32 inches unless a continuous support such as Uponor PEX-a Pipe Support is used. Then:
 1. 1/2 - 3/4 inch pipe: 6 feet
 2. 1 - 3 inch pipe: 8 feet
- O. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.

- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 21 05 29

SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- D. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS

1.2 DEFINITIONS

- A. IBC: International Building Code.

1.3 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35 inch deflection.
- E. All elastomeric isolators shall be of high quality synthetic rubber with anti-ozone and anti-oxidant additives.
- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts and

washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs./sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- I. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- J. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- K. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
 - 1. Offices
 - a. Executive: 30
 - b. Conference rooms: 30
 - c. Private: 35
 - d. Open-plan areas: 35
 - e. Computer/business machine areas: 40
 - f. Public circulation: 40
 - 2. Schools
 - a. Lecture and classrooms: 30
 - b. Open-plan classrooms: 35
 - 3. Libraries: 25
 - 4. Theaters
 - a. Theater: 25
 - b. Stage house: 25
 - c. Trap room: 25
 - d. Orchestra pit: 25
 - e. Rehearsal rooms: 25
 - f. Teaching studios: 30
 - g. Practice rooms: 30
 - h. Ensemble rooms: 30
 - i. Shop: 45

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.
- H. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. All fire suppression systems vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

- A. All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.
 - 1. Manufacturers:
 - a. Mason Industries
 - b. Kinetics Noise Control
 - c. Amber / Booth
 - d. Vibration Eliminator
- B. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the

equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- C. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- D. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- E. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- F. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- G. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- H. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

- I. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- J. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.2 BASES

- A. Type WF: A welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.
- B. Type ICS: Vibration isolation manufacturer shall provide steel members welded to height-saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent misalignment of equipment.
- C. Type RBMK. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, formed steel bases and sheet metal formed bases are not acceptable. Bases for split-case pumps shall be large enough to provide for suction and discharge elbows. Bases may be T or L shaped where space is a problem. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2-inch bars welded in place on 6-inch centers running both ways in a layer 1-1/2

inches above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height-saving brackets shall be employed in all mounting locations to maintain a 1-inch operating clearance under base.

2.3 FLEXIBLE PIPE CONNECTIONS

- A. Type SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR: Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

2.4 MECHANICAL ANCHOR BOLTS

- A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 ADHESIVE ANCHOR BOLTS

- A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place Concrete."]
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Locate isolation hangers as near the overhead support structure as possible.
- D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

- E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- K. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least **[four]** **<Insert number>** of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 21 05 48.13

SECTION 21 11 13 - FIRE SUPPRESSION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- E. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Contractor shall include within his bid all materials and Work to provide standpipe and 100% sprinkler protection for all areas in new construction or for the entire smoke compartment affected by renovation work.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- E. Interface all new flow and valve supervisory switches with building fire and smoke alarm systems.
- F. *Provide temporary fire protection during the construction phase of Project. Inform and obtain approval from the Owner and General Contractor for any interruptions of existing fire protection, domestic water or fire alarm systems. Adhere to ADM1131 Facilities Planned Utility Outages Policy for outage and shutdown requests.*
- G. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.3 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation of a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.

1.4 SYSTEMS

- A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Pipes, fittings, and specialties
 - 2. Standpipe systems
 - 3. Automatic Sprinkler Systems
 - 4. Combination Standpipe/Automatic Sprinkler Risers
 - 5. Automatic Dry Sprinkler Systems
 - 6. Pre-action Sprinkler Systems
 - 7. Fire Department Valve Cabinets
 - 8. ESFR Sprinkler Systems

1.5 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.1 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
 - 1. The International Fire Prevention Code
 - 2. The International Building Code
 - 3. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 101 - Life Safety Code
 - b. NFPA 13 - Installation of Sprinkler Systems
 - c. NFPA 14 - Installation of Standpipe and Hose Systems
 - d. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems

- B. Factory Mutual (FM) Approval Guide
- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

1.2 SYSTEM DESCRIPTIONS

- A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- B. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- C. Automatic Wet-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- D. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- E. Automatic Dry-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- F. Automatic Dry-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- G. Combination Standpipe/Automatic Sprinkler Risers:
 - 1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility. Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-1/2" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
 - 2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
 - 3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.
 - 4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.

5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.
- H. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- I. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.
- J. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
- K. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
- L. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
- M. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.
- N. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and **[ASCE/SEI 7] <Insert requirement>**.

1.3 DESIGN CRITERIA

- A. Any design documents issued to the contractor are for information only. The Contractor shall be responsible for all code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. The Contractor shall arrange for, and conduct a flow test and coordinate its validity with the Authorities Having Jurisdiction.
- B. Upon award of the Contract, a new flow test from the two (2) hydrants nearest the site service entry is to be performed by the Contractor to confirm the flow and pressure characteristics of the existing water service. The completed flow test data along with a utility service map of the area is to be forwarded to the Engineer for confirmation of the existing water service.
- C. Where pre-design of the sprinkler system is required for submission for the building permit: The Fire Protection documents were prepared to be in compliance with all

applicable codes and flow test data provided. The Contractor shall review all documents provided and report any modifications required to these documents to the Design Engineer during the shop drawing preparation stage.

- D. All sprinkler heads in occupied areas are to be fast response type heads (155 degrees – 165 degrees Fahrenheit).
- E. All occupied, heated spaces will be protected by wet sprinkler systems.
- F. Inspector test valves will be protected by wet sprinkler systems.
- G. Automatic sprinkler systems shall be designed to the available domestic water pressure available and shall be hydraulically calculated for the following design standards:
 - 1. NFPA 13 Systems

Area/ Usage	Hazard Classificatio n	Density GPM/Sq. Ft.	Remote Area	Maximum Head Spacing	Interior Hose Stream
Public Spaces, Lobbies, Corridors, Offices, Restaurants, Lounges, Meeting Rooms	Light	.10	1,500 sq. ft.	130-200 sq.ft.	100 gpm
Dry Pipe System:	Light	.09	1,950 sq. ft.	130-200 sq.ft.	100 gpm
Mechanical Rooms, Electrical Rooms, Elevator Equipment Rooms, Maintenance/ Storage Rooms, Kitchen/ Food Service Areas and Laundry	Ordinary Group 1	.15	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System: Parking Garages, Non- heated Attic Spaces, Ceiling Spaces, Porte Cochere and other spaces containing sprinkler piping that do not have alternate provisions to guarantee a 40° F temperature.	Ordinary Group 1	.14	1,950 sq. ft.	130 sq. ft.	250 gpm
Ballrooms, exterior loading docks, distilleries, barns and stables, dry cleaners, libraries, machine rooms, and auto repair shops.	Ordinary Group 2	.20	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System:	Ordinary Group 2	.19	1,950 sq. ft.	130 sq. ft.	250 gpm
Upholstery shops, sawmills, plywood manufacturers, or textile factories, Low-pilled storage, dust or lint generated areas, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper.	Extra Hazard Group 1	.30	2,500 sq. ft.	90-130 sq. ft.	500 gpm
Plastic manufacturing operations, steel manufacturing, and automobile paint spray booths, Space with high combustible or flammable liquids, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper	Extra Hazard Group 2	.40	2,500 sq. ft.	90-130 sq. ft.	500 gpm

- H. Available fire-hydrant flow test records indicate the following conditions:
1. Date: **<Insert test date>**
 2. Time: : **<Insert time> [a.m.] [p.m.]**
 3. Performed by: **<Insert operator's name> of <Insert firm>**
 4. Location of Residual fire Hydrant R: **<Insert location>**
 5. Location of Flow fire Hydrant R: **<Insert location>**
 6. Static Pressure at Residual Fire Hydrant R: **<Insert psig >**
 7. Measured Flow at Flow Fire Hydrant F: **<Insert gpm >**
 8. Residual Pressure at Residual Fire Hydrant R: **<Insert psig >**
- I. The fire protection system design shall include a minimum of 10 psi safety factor to allow for future losses in the water service pressure characteristics. The fire protection systems shall not be designed to operate if the residual pressure of the existing water service falls to 20 psi or lower at design flow requirements.
- J. The maximum allowable system velocities shall not exceed 20 fps unless alternate criteria are required by the Owner's Insurance Underwriter.
- K. Coordination:
1. The Fire Protection Contractor shall review the complete set of project documents and coordinate his work with all other trades involved.
 2. Sprinkler head locations shall be coordinated with the architectural reflected ceiling plans. Locations of sidewall heads shall be coordinated with architectural interior elevations.
 3. The fire protection piping and head layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, and ductwork.
- L. Sprinkler Systems
1. Any design documents issued to the Contractor are for information only. The Contractor shall be responsible for the actual layouts, general routing of piping and additional sprinkler heads to meet all requirements.
- M. All underground mains and appurtenances are to be installed according to NFPA 24.
- N. Combination Standpipe/Automatic Sprinkler Risers
1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility. Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-1/2" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
 2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
 3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.

4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.
5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.

O. Fire Protection System Alarms

1. The fire protection contractor shall coordinate location and function of all flow, air pressure, supervisory switches, and other dry contacts with the fire alarm contractor.
2. All control valves in the fire protection system shall be provided with supervisory switches wired for annunciation at the main FACP.
3. Automatic sprinkler system connections shall be provided with flow switches adjacent to the zone control valve wired for annunciation at the main FACP.
4. Upright automatic sprinklers will be provided in all elevator shafts and elevator machine rooms. The service to each of these spaces shall be provided with an individual control valve with a supervisory switch and a flow switch located in an adjacent room and wired for annunciation at the main Fire Alarm Control Panel (FACP).

1.4 EQUIPMENT, MATERIALS, BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.5 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.6 PRECONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.7 SUBMITTALS

- A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.
- B. Review of the Drawings and hydraulic calculations by PBK is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. PBK is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. PBK shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.
- C. Fire Protection shop drawings shall include all data required by NFPA Section 13. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. The Contractor shall submit shop drawings to and secure approval of the Owner's Underwriter, local authority and/or state authorities prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:
 - 1. Fire department valves
 - 2. Sprinkler heads and accessories
 - 3. Siamese Fire Department connection
 - 4. Fire valve cabinets
 - 5. Test header
 - 6. Roof manifold
 - 7. Backflow preventer
 - 8. Cutting oil indicating compatibility with the CPVC sprinkler piping
- D. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:
 - 1. Pipe and fittings
 - 2. Valves
 - 3. Pipe supports
 - 4. Pipe accessories

5. Pipe labels and valve tags
 6. Flow switches
 7. Tamper switches
- E. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
- F. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.
- G. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.
- H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.8 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
1. Facilities with less than 300 sprinklers – 6 minimum
 2. Facilities with 300 to 1000 sprinklers – 12 minimum
 3. Facilities with over 1000 sprinklers – 24 minimum

PART 2 - PRODUCTS

2.1 GENERAL

- A. All sprinkler system equipment is to be UL Listed or FM Approved.
- B. Manufacturers.
1. Pipe.
 - a. Wheatland Tube
 - b. Youngstown Tube Company
 - c. Bull Moose Tube
 - d. Paragon
 2. Sprinkler and Alarm Valve.
 - a. Viking Corp
 - b. Globe Fire Sprinkler Corp
 - c. Tyco
 - d. Reliable
 - e. Victaulic Company
 3. Valve
 - a. Milwaukee
 - b. NIBCO
 - c. Bray
 - d. Mueller Co
 - e. Tyco Fire
 - f. Victaulic Company
 - g. Crane

4. Specialty Valve
 - a. Potter-Roemer
 - b. Croker
 - c. Guardian Fire Equipment
 - d. Elkhart Brass Mfg
 - e. Tyco Fire
- C. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.
- D. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.
- E. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.2 MATERIALS

- A. All piping shall be made in the USA and be labeled according to City and /or State manufacturers. Pipe shall be protected with MIC shield coating.
- B. All materials, pipe, valves and equipment furnished under this section shall be new and approved by NFPA, Underwriters Laboratories Inc. (UL), Factory Mutual (FM) and American Water Works Association (AWWA) where applicable.
- C. Pipe and Fittings:
 1. Piping – Schedule 40 ASTM A-53, A-795, A-135, black steel piping for branches (1 inch – 2 inches) and schedule 10 ASTM A-53, A-795, A-135 (2-1/2 inches – 8 inches) black steel for mains.
 - a. Piping (piping only, excluding fittings) for dry systems shall be Schedule 40 ASTM 53 galvanized steel in all pipe sizes, screwed galvanized cast or malleable iron fittings through 2", grooved couplings for 2-1/2" and larger pipe sizes.
 - b. Buried Water Service Entrance Piping.
 - 1) Pipe - Cement mortar lined ductile iron.
 - 2) Fittings – Cement mortar lined ductile iron using mechanical joints.
 - 3) Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.
 - 4) All pipe and fittings shall be encased with polyethylene film having a minimum thickness of 8 mils.
 2. Fittings under 2-1/2 inches screwed cast iron, 175-pound S.W.P., 2-1/2 inches and larger, flanged, or grooved pipe and fittings to accept a bolted type clamp with gasket.
 3. Grooved Couplings & Fittings: ductile iron with gasket and two bolts, 300 psi working pressure. Victaulic, Firelock fittings.

4. Flanges – cast iron, 175 pound S.W.P., with threaded inlet, or Victaulic Mod. #741.
 5. Hangers to meet NFPA 13 spacing and type.
- D. Control Valves: All control valves are to be electrically supervised. A pressure gauge, water flow switch and test connection with drain shall be provided downstream. The installation shall be per NFPA 13 requirements.
1. 2-1/2 inches and under – 175 psi, Milwaukee “Butterball” with built-in tamper switches.
 2. Over 2-1/2 inches – UL listed and FM approved, 175 psi, butterfly valves or OS&Y with tamper switch.
 3. All butterfly valves shall have a built in tamper resistant switch for supervision of the open position. The switch shall be contained within a NEMA Type 1, general purpose indoor rated housing. Either unauthorized removal of the switch housing (when the valve is open) or closing the valve, shall cause the switch contacts to change position. The switch shall have four conductors to accommodate connections to Style 4 or Style 6 signaling line circuit devices.
- E. Check Valves:
1. Check valves 2-1/2 inches and larger shall be iron body swing check with cast brass hinge, rod, and brass faced discs.
 2. Check valves 2 inches and smaller shall be UL listed brass body and all brass fitted.
- F. Alarm Check Valves: Shall be for vertical installation, cast iron, complete with retard chamberport to alarm, pressure gauges, main drain, electric alarm pressure switch with dual contacts suitable for either open or closed circuit.
1. Control valve, check valve, and pressure or flow switch tied to fire alarm system and sprinkler alarm bell.
 - a. 2-1/2" to 3, Class 150, iron body, bronze disc, flanged or groove ends, TYCO Fire Products LP; AV-1-300, UL Listed for fire service.
 - b. 4" and larger, Class 150, iron body, bronze trim, flanged ends, TYCO Fire Products LP; AV-1-300, flanged, UL Listed for fire service.
- G. Dry Check Valves: Subject to compliance with requirements, provide TYCO Fire Products LP; DPV-1.
1. Standard: UL 260
 2. Design: Differential-pressure type
 3. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 4. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc,
 - 3) Viking Corporation.
 - c. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

- d. Motor Horsepower: Fractional.
 - e. Power: 120-V ac, 60 Hz, single phase.
- H. Preaction System:
 - 1. [Double interlock] [single interlock] [non-interlock] pre-action valve and trim to NFPA 13 and UL listed for fire services.
 - 2. Valve and trim assembly to complete with all required valves, alarm line pressure switches, air supervisory switches, valve position supervisory switches, alarms, pressure gauges and alarm test connections.
 - 3. [Air supply system capable of charging the piping system to required pressure within 30 minutes, complete with air compressor, air tank, ball valve and pressure switch] [Connect to building utility air system] to maintain sprinkler system piping pressurization.
 - 4. [Preaction valve and all components preassembled within a lockable steel metal enclosure, red color, pre-wired electrical connections, system control panel and pressure readings visible from front of cabinet, accessible side and back panels].
- I. Switches:
 - 1. Water Flow Switches: Shall be paddle type water flow alarm (or pressure switch of retard chamber) and with double contacts for either open or closed circuit operation for connection to building fire alarm system.
 - 2. Tamper Switches: Shall be designed as an integral part of control valve assembly or tamper switch shall have double acting, spring loaded plunger to activate a single-pole double-throw switch for valve supervision of OS&Y type control valves.
- J. Fire Department Connections (as indicated on plans):
 - 1. Fire department connection shall be 2-way exposed Siamese type, 2-1/2" x 2-1/2" x 4" size, cast brass body, polished chrome finish for all exposed surfaces, cast brass escutcheon, and brass female hose inlets having individual clapper valves, plugs, and chains. Assembly shall be located with the center line of the hose inlets at 2'-6" above adjacent grade. Inlet threading shall be National Standard or same as municipal fire department, as required. Assembly shall be UL Listed, FM Approved. Wall Mounted: Potter Roemer 5710 series or approved equal.
 - 2. Free Standing: Potter Roemer 5760 series or approved equal.
- K. Sprinkler Head Escutcheons.
 - 1. Finish for all escutcheons shall match the finish of sprinkler heads on which they are used. Use white cover plates for white painted soffits and white acoustical ceiling tile, black cover plates for black lay-in acoustical ceiling tile, custom color to match specialty ceilings.
- L. Water Motor Gong
 - 1. Provide a water motor gong. No Electric Bell.
- M. Fire Valve Cabinet
 - 1. 1810 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve with cap and chain; 1810-10 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve, 2-1/2" x 1-1/2" Reducer and 1-1/2" Cap.
 - 2. Cabinet shall be 20-gauge steel with polyester coating, recessed with flush full metal hinged door with cam catch and integral shelf for fire extinguisher. Cabinet shall be Potter-Roemer 1810 series or approved equal.

N. Roof Manifold

1. Wall mount manifold to be three outlet horizontal configuration, cast brass body with threaded 2-1/2" male outlets complete with valves, chains and caps, rough brass finish. Provide accessible indicating type shut off valve with supervisory switch (normally closed) and automatic ball drip to roof. Roof manifold to be Potter-Roemer 5880 series or approved equal.

2.3 STAND PIPES

- A. Provide a complete stand pipe system with 2 1/2" fire hose connections in compliance with Authority Having Jurisdiction Fire Marshal's requirements for the entire building with separate stand-pipes at auditorium stage and entrance to the auditorium.
1. Building system shall provide a 2 1/2" fire hose connection at each landing of each egress stairwell and additional connections throughout the facility in order to provide complete fire hose coverage based on a 150 foot of hose with 50 foot of water spray. Locate fire hose connections in Fire Marshal and Architect approved locations such as stairwells and mechanical rooms and provide required signage. Contractor shall include stand pipe water flow requirements in hydraulic calculation for sizing of all fire water main piping and fire pump. Contractor shall include in submittal a plan showing location of all fire hose connections for approval by Authority Having Jurisdiction Fire Marshal prior to fabrication and rough-in. System shall also comply with NFPA 13 for hose connections for fire department use.
 2. Provide a complete stand pipe system on each side of the auditorium stage.
 3. Provide a complete stand pipe system on each side of the entrance to the auditorium.

2.4 AUTOMATIC SPRINKLER SYSTEM MATERIALS

- A. The underground fire protection service shall be provided with thrust blocks and rods and clamps at the service entry.
- B. Automatic sprinklers shall be provided as follows:
1. Public Spaces with Gypsum and Lay-in Ceilings
 - a. Fully concealed type sprinklers, glass element, or fusible link style, quick response sprinklers shall be provided in all areas with gypsum ceilings and lay in ceiling unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Ceiling coverplate shall be factory painted to match the adjacent ceiling color; submit painted sample to the Architect for approval. Sprinkler to be Tyco, Reliable, Victaulic or Viking Horizon Mirage concealed sprinkler or approved equal.
 2. Back-of-House Spaces and Unfinished Spaces with no Ceiling
 - a. Quick response upright pendent sprinklers shall be provided in all areas with no ceiling. Temperature rating is to be 165 degrees unless conditions require higher temperature. Finish of sprinkler to be rough brass. Sprinkler to be Tyco, Reliable or Viking Microfast Model M.
 3. Kitchen Coolers and Freezers
 - a. Standard response semi-recessed chrome plated dry pendent sprinklers with sprinkler guards will be provided in all coolers and freezers. Barrel length shall be a minimum of 12" from the base of the tee to the top of the freezer. Sprinkler and escutcheon shall be polished chrome finish. Sprinkler shall be Tyco, Reliable or Viking Model M.
 4. Pool areas

- a. All sprinkler heads in pool areas, pool equipment room, sanitized room and acid room shall be US Listed/FM Approved quick-response Stainless Steel heads (155 degrees Fahrenheit). Heads must be wax coated. Viking VK338 and VK339 or equal
- 5. Exterior Overhangs and Elevator Shafts
 - a. Standard response chrome plated dry horizontal sidewall or upright sprinklers are to be provided. Barrel length shall be a minimum of 12". Sprinkler and escutcheon shall have UL Listed polyester or Teflon corrosion protection at exterior overhangs and rough brass finish at elevator shafts. Sprinkler shall be Viking Model M.
- C. All outdoor sprinkler heads shall be wax coated.
- D. Alternate acceptable manufacturers with equivalent sprinklers are Automatic, Central, Anvil International, Gem and Reliable.
- E. Sprinkler guards shall be installed on all sprinklers 7'-0" or less above floor.
- F. Provide sprinklers at the highest and lowest level of all stairwells.
- G. Provide sidewall sprinklers at the top end and bottom of all elevator hoistways. Sprinklers may be omitted from traction elevators on non-combustible elevator shafts and cabs which meet the requirements of ASME A.17.1 and where acceptable to the local authorities.
- H. Provide sprinklers in electrical rooms and elevator machine rooms unless specifically prohibited by local authorities; the sprinkler supply to each space shall be provided with a supervised valve and flow switch. Coordinate the intermediate temperature rating of the sprinkler head in all elevator machine rooms with the electrical contractor to ensure sprinkler operation will not occur prior to activation of the heat detector and the shunt trip circuit breaker.
- I. Sidewall sprinklers shall be installed in all electrical rooms, electrical closets and elevator machine rooms where adequate coverage is provided. Upright sprinklers shall be installed in these spaces when coverage limitations of the sidewall sprinklers are exceeded. Piping shall not be installed above any electrical equipment, switchboard or panelboard. Piping shall offset around surface mounted light fixtures where possible, provide a minimum of 6" clearance below the bottom of the light fixtures at all locations.
- J. The property is to be fully sprinklered throughout per the requirements of NFPA unless specifically noted otherwise. Elimination of sprinklers in electrical rooms, elevator shafts and elevator machine rooms shall be clearly indicated on the shop drawing submittal noting the exception applied for the deletion of sprinklers in these spaces.
- K. The Contractor shall provide and place suitable signs indicating the purpose of each control valve, test connection, main and auxiliary drain, etc., as required.
- L. Provide higher intermediate temperature rated sprinklers in all areas required due to service conditions and as required by NFPA 13.
- M. Provide sprinkler connections to all required food service hood suppression systems.
- N. Sprinkler guards shall be installed on all sprinklers located in cafeteria and the gym.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.
- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles. For every sprinkler head, tap main/branch pipe serving each individual sprinkler head shall come from the top of pipe to prevent trash from collecting at head. **(Piping laterals to a sprinkler head is FORBIDDEN off the bottom of the main or lateral piping system).**
- G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- I. Dry pipe systems shall be specified as installed with the longitudinal weld seam located above the horizontal centerline of the pipe, and with drain valves installed at all low points regardless of trapped water volume. Require that mains and branch lines be pitched at least 1 /2 in. per 10 ft in all locations, including in non-refrigerated areas (areas not subject to freezing).
- J. Provide a pressure gauge at the top level of all standpipes.

- K. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- L. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- M. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- N. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, gymnasium areas, storage rooms and all unfinished areas where the head is less than 7 feet-0 inches above finished floor.
- O. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- P. Building shall be 100 percent fully sprinklered.
- Q. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- R. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.
- S. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- T. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- U. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 CLEANING

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.
- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.4 TESTS

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the "Contractor's Materials and Test Certificate" shall be submitted to the Architect.
- B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- E. Prior to final acceptance by the Owner, submit the "Contractor's Material and Test Certificates" indicating system compliance with all applicable sections of NFPA.

END OF SECTION 21 11 13

SECTION 22 05 00 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide all work for plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.
- B. All materials and equipment for the potable water system shall meet the latest amendments, mandates, and requirements for lead free required by law that went into effect January 2014.
- C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc., required and/or necessary to completely install, clean, inspect, adjust, test, balance, and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- D. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the building(s) and plumbing and fire protection systems that must remain operational.
 - 2. Contractor shall include all temporary services required to keep the Owner-occupied portions of the building(s) operational without interruption of plumbing and fire protection services for the duration of the project.
 - 3. Refer to architectural Drawings for description of phasing, stage all plumbing work and fire protection work accordingly.
- E. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawings and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.
- F. Unless directly specified otherwise, all noted pipe diameters herein are nominal.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, Specifications, local ordinances, industry standards, utility company regulations, and nationally accepted codes.
- B. All materials, distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused, of United States domestic manufacture, and comply with the Buy America Act, unless approved otherwise by the Engineer or Owner.

- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer to not be an inherent part of the systems as designed without additional cost to the Owner.
- E. An approved Contractor for the work under this Division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than (3) systems of comparable size and type that have served their Owners satisfactorily for not less than (3) years.

1.4 WORK INCLUDED

- A. Systems: Plumbing systems installed, and the work performed under this Division of the Specifications, shall include, but are not necessarily limited to, the following systems as noted below. The connection point for all systems from the site utilities shall be at 5'-0" from the exterior of the building unless specifically noted otherwise.
 - 1. Compressed air system
 - 2. Domestic cold water, hot water, hot water recirculation systems
 - 3. Domestic water softening system
 - 4. Fuel oil system
 - 5. Grease waste and waste systems from food service areas
 - 6. Natural gas systems
 - 7. Primary storm drainage, secondary storm drainage systems
 - 8. Propane/air mixture gas systems
 - 9. Sanitary drainage, waste, vent systems
- B. Contract quality control including workmanship, manufacturer's instructions, mock-ups, and demonstrations.
 - 1. Executing Mock-ups:
 - a. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals, and finishes.
 - b. Do not proceed with any work involving a mock-up until the related mock-up has been approved in writing.
 - c. Acceptable mock-ups in place shall be retained in the completed work.
 - d. Perform tests and submit results as specified.
 - 2. Scheduling Mock-ups: Schedule demonstration and observation of mock-ups, in phases, with Architect/Engineer for:
 - a. Rough-in
 - b. Finish with all appurtenances in place
 - c. Insulation installed

d. Demonstrations

1.5 COMPLETE PERFORMANCE OF WORK

- A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Drawings and Specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.
- B. Provide all rigging required for complete installation and furnish Drawings showing necessary points of support, reactions, and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.
- C. Become thoroughly acquainted with the work involved; obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this Division necessary for the proper installation of their Contracts. Confer with other Contractors for finish adjacent to work of this Section and arrange to have visible portions of the work (e.g., access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architect.
- D. Transmit to trades doing work of other Sections all information required for work to be provided under their respective Sections (e.g., freshwater connections, foundations, electric wiring, access doors, etc.) in ample time for installation.
- E. Where disagreements occur between the Plans and the Specifications, or within either document itself, the item or arrangement of better quality, greater quantity, or higher cost shall be included in the Base Bid.

1.6 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this Division with all other Divisions to ensure that all components of plumbing and fire protection systems will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the plumbing and fire protection systems' components.
- C. Make all plumbing and fire protection connections to all equipment furnished by this Division and as required by any other Division.
- D. Electrical wiring, control equipment, and motor starters indicated on the electrical Drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the plumbing trades, either in these Specifications or on the plumbing Drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical Drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these Specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with plumbing equipment shall have overload protection in all phases. It shall be the responsibility of each Subcontractor furnishing motors and devices to advise electrical

Contractor of exact function of systems to assure proper type of starter with correct number of auxiliary contacts for proper operation of the system.

- F. The plumbing trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner because of lack of such coordination.
- G. The design of the electrical system(s) is based on the plumbing equipment specified and scheduled on the Drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the plumbing trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems shall be furnished and installed under Division 26. Coordinate locations with electrical Contractor.

1.7 DRAWINGS

- A. The Drawings are schematic in nature but shows the various components of the system(s) approximately to scale and attempts to indicate how they are to be integrated with other parts of the building. Contractor shall determine exact locations by review of equipment manufacturer's data, jobsite measurements, checking the requirements of other trades, and reviewing all Contract Documents. The size of the plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed and approved manufacturers shall be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The Drawings are not intended to show exact locations of pipes and ducts, nor to indicate all offsets, fittings, and supports, but rather to indicate approximate layout.
- B. The mechanical, electrical, plumbing, and fire protection Drawings are necessarily diagrammatic in nature and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances, structural conditions, and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases, suspended ceilings, soffits, finished portions of the building, etc., unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing, and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system(s) involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement, and extent of equipment, devices, and other appurtenances related to the installation of the work shown on the Drawings are approximate. The

Contractor shall not scale Drawings; rather, the Contractor shall refer to the Architect Drawings for exact dimensions of building components. Should a conflict exist between the Architect and Engineer Drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.

- E. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. The Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.8 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in these Specifications and the procedures covered by these Specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. Refer to Division 01 Specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cutsheets, performance and test data, and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who, in their judgement, is unsuitable for use on the Project and that decision shall be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request, identify the product, fabrication method, or installation method to be replaced by the substitution; include related Specifications Section(s), Drawing(s), and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate with each request, the following information:
 - 1. Product data, drawings, and descriptions of products, fabrication methods, and installation procedures.
 - 2. Samples where applicable or requested.
 - 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance, and visual effect where applicable.
 - 4. Coordination information, including a list of changes or modifications needed by other parts of the work and construction, to be performed by the Owner and separator Contractors that will become necessary to accommodate the proposed substitution.
 - 5. A statement indicating the effect the substitution will have on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

6. Cost information, including a proposal of the net change, if any, in the Contract Sum.
7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including the Architect and Engineer's redesign and evaluation costs, resulting from the use of the proposed substitution.
9. Conditions: The Contractor's request for substitution will be received and considered when extensive revisions to the Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented, properly submitted, and when one (1) or more of the above conditions are satisfied, then the substitution will be judged and determined by the Architect and Engineer; otherwise, the requests will be returned without action except to record non-compliance with these conditions and requirements.

1.9 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each Specifications Section.
- B. Coordination drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the ductwork and piping as well as the major mechanical, plumbing, and fire protection equipment are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at one-eighth (0.125) inch scale or larger and drawing per building area. Provide one-quarter (0.25) inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop drawings will be reviewed and returned to the Contractor with one of the following categories:
 1. **Reviewed:** No further submittal action is required. Submittal shall be included in the Operation and Maintenance (O & M) manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in the comments section of the Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and shall be required to furnish product(s) named in the Specifications and/or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that the required correction(s) noted on the Engineer's Submittal Cover Letter have been received and complied with by the manufacturer(s). If equipment onsite is not in compliance with the correction(s) noted, then the Contractor shall be responsible for the cost of removing and replacing the equipment.

- D. Materials and equipment which are purchased or installed without submittal review and approval will be removed and replaced with specified equipment at the Contractor's expense.
- E. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc., shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to which item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc., of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.10 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 – General Requirements and each Specification Section.

1.11 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the plumbing or fire protection system components within the available space as indicated on the Drawings, the Contractor shall prepare a sketch to the minimum one-eighth (0.125) inch scale clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the Contract Documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.12 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these Contract Documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Service outages required by the new installation shall only be permitted at a time approved by the Owner. The Contractor shall allow the Owner a two (2) week window to schedule required outages. The time allowed for outages shall not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
 - 1. During the construction of this project, normal facility activities will continue in existing building(s) until the new building(s) or renovated area(s) are completed.

Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building(s).

D. Demolition and Work Within Existing Building(s):

1. In the preparation of these documents, every effort has been made to show the approximate locations of – and connections to – the existing piping, duct, equipment, and other apparatus related to this phase of the work; however, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the existing facilities and related areas. Prior to the submission of a proposal, the Contractor shall inspect and verify all details and requirements of all the Contract Documents. All discrepancies between the Contract Documents and actual jobsite conditions shall be resolved by the Contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this contract.
2. All equipment and/or systems noted on the Contract Drawings “TO REMAIN” shall be inspected and tested onsite to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions/costs, shall be made by the Contractor to the Architect/Engineer for review.
3. All equipment and/or systems noted on the Contract Drawings “TO BE REMOVED” shall be removed—including associated system connections. Where duct or pipe is to be capped for future extension or end-of-line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an associated electrical connection, the Electrical Contractor shall disconnect equipment and remove wiring back to the panel or disconnect switch. Contractor shall remove or relocate equipment and the associated disconnect.
4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing building(s) or be conducted in a manner causing harm or danger to any person(s) on the premises. All fire exits, stairs, or corridors required for proper access, circulation, or exit shall remain clear of equipment, materials, or debris. The General Contractor shall maintain barricades separating the work area(s) from the occupied area(s).
5. Certain work during the demolition and construction phases of the construction process may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation(s) with the Project Administrator at least seventy-two (72) hours in advance in writing.
6. Any salvageable equipment, as determined by the Owner, shall be delivered to the Owner and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
7. Equipment, piping, or other potential hazards to the occupants of the building shall not be left overnight nor outside of the designated working or construction area(s).

8. The Contractor shall make every effort to minimize damage to the existing building(s) and the Owner's property. Repair, patch, or replace as required any damage which might occur because of work at the jobsite. Care shall be taken to minimize interference with the Owner's activities during construction and to keep the construction-disrupted area(s) to a minimum.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of existing equipment and plumbing fixtures as required by the field conditions to allow the installation of the new system(s) regardless of whether such rerouting, reconnecting, or relocating is explicitly shown on the Contract Drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation, and plumbing services for the existing area(s).
10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls, and appurtenances not included in the remodel or alteration area(s) shall remain in place.
11. Pipe, duct, equipment, and controls that are disconnected to perform remodeling work shall be reconnected in such a manner as to leave system(s) in proper operating condition.
12. No portion of the fire protection system(s) shall be turned off, modified, or changed in any way without the express knowledge and written permission of the Owner's representative(s) to protect the system(s) that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with minimized disruption or downtime.
14. Refer to architectural demolition and/or alteration Drawings for actual location(s) of walls, ceilings, etc., being removed and/or altered.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials onsite in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage by storing in original packaging.
- C. Do not deliver items to jobsite before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.14 GENERAL ELECTRIC REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices, and control wiring when specified or required for proper operation of electrical systems associated with plumbing equipment specified in Division 22.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. The Contractor shall notify the Architect/Engineer fourteen (14) days in advance in writing before bids are due if it is necessary to adjust the horsepower of any motors or modify any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.15 ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

- A. Plumbing equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall include any transformers for equipment requiring other voltages (277 volt, 120 volt, 24 volt, etc.).
- C. During the submittal process, any proposed deviations from the specified equipment in the Contract Documents shall be clearly indicated on the Plumbing submittal(s). Voltages shall match that of the specified equipment in the Contract Documents; however, if the submitted equipment ampacity, horsepower, etc., differs from the specified equipment, then the Contractor shall coordinate any changes required for the submitted equipment's electrical characteristics with the Electrical Contractor at no additional cost to the Owner.
- D. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having the starting and running characteristics consistent with the torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of the driven equipment on the Shop Drawings.
 - 3. Contractor shall verify electrical characteristics of each motor with the Electrical Drawings.
 - 4. Motors which are shipped loose from equipment shall be set by the supplying Subcontractor.
 - 5. Alignment of motors factory-coupled to equipment and motors field-coupled to equipment shall be rechecked by the millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and rechecked again after forty-eight (48) hours of operation in designed service.
 - 6. Where possible, motors shall be factory mounted.

1.16 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.
- B. The original set of as-built drawings shall be scanned and transmitted to the Architect/Engineer in both full size bond (print) and Portable Document Format (PDF).
- C. As-Built drawings: Two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each of PDF and AutoCAD 2015 files on a compact disc (CD).
 - 1. Number of Copies: Submit one (1) set of marked-up as-built prints.

2. Number of Copies: Submit copies of as-built drawings.
 - a. Initial Submittal:
 - 1) Submit PDF of scanned as-built prints and one (1) set of the prints itself.
 - 2) Submit as-built AutoCAD digital files and one (1) set of the files plotted in PDF.
 - 3) Architect will indicate whether general scope of changes, additional information record, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF of scanned as-built prints and three (3) sets of prints itself.
 - 2) Submit as-built AutoCAD digital files and three (3) sets of the files plotted in PDF.
 - 3) Plot each drawing file whether changes and additional information were recorded.
- D. As-built drawings should indicate the following information at a minimum:
 1. Indicate all addendum changes to the Contract Documents.
 2. Remove Engineer's seal, name, address, and logo from the drawings.
 3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
 4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.
 5. Indicate all changes to construction during the construction process.
 6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
 7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.
 8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
 9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.
 10. Location and size of all plumbing piping above ceiling—including exact locations of valves.
 11. Indicate exact locations of all fire protection sprinkler heads and zone valves in the system.

12. Indicate exact locations of all roof-mounted equipment, wall, roof, and floor penetrations.
13. Indicate all changes with clouding around said changes.

1.17 STARTUP SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and startup of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report shall be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the Owner's personnel shall be provided following certification of the assembly.

1.18 COORDINATION OF TRADES

- A. The Contractor shall give full cooperation to other trades and shall furnish all information necessary to permit the work of all other trades to be installed satisfactorily and with the least possible interference or delay.
- B. Piping, fixtures, and plumbing equipment shall not be installed without first coordinating the installation of it with other trades. The Contractor, at their own expense, shall relocate all piping, fixtures, and plumbing equipment installed without coordination should the plumbing elements interfere with the proper installation and mounting of electrical elements, mechanical elements, technology elements, ceilings, architectural elements, and structural elements.
- C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other trades and disciplines prior to installation.
- D. In areas where more than one trade is required to utilize common openings in structural beams, joists, chases, shafts, and sleeves for the passage of conduits, raceways, piping, ductwork, and other materials, the Contractor shall coordinate the positions of all piping and plumbing equipment to be furnished under this Division so that all items, including the materials and equipment of other trades and disciplines, may be accommodated within the space available.
- E. The Contractor shall confirm that work installed under this Division does not interfere with the clearances required for finished columns, pilasters, partitions, walls, or other architectural and structural elements as shown on the Contract Documents.
- F. Work that is installed under this contract and interferes with the architectural design or building structure shall be removed and relocated as required at no additional cost to the Contract Documents.
- G. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and architectural finish conditions affecting all their work and shall arrange such work accordingly for the complete and satisfactory operation of all systems. The Contractor shall provide all offsets, fittings, valves, devices, and accessories that may be required to meet such conditions.

1.19 WARRANTY

- A. All equipment furnished and installed under this Division shall be provided with the manufacturer's standard warranty unless otherwise noted.

- B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. To “make good all defects” shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.
- B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment shall bear the inspection label of Underwriters Laboratories.
- D. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.
- E. Cast iron waste piping and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

- A. Acceptable manufacturers:
 - 1. Precision Plumbing Products
 - 2. MIFAB
 - 3. Acudor
 - 4. Elmdor
 - 5. Milcor
- B. Group valves together above suspending ceilings, walls, furred spaces, etc. to minimize the number of access panels required, but with all valves freely accessible for easy maintenance and inspection. Locate all valves within 1'-0" of the access panel entry point. Minimum size requirements shall be:
 - 1. 18" X 18" for electrical-related items
 - 2. 24" X 24" for plumbing-related items
 - 3. 36" X 36" for mechanical-related items
- C. Furnish access panels of proper size to service concealed valves, cleanouts, etc. as required. Panels shall be of the proper type for the material in which they occur and are to be furnished by the Contractor but installed by the trade for the material in which the access panel is installed.
- D. Panels shall have flush doors with sixteen (16) gauge steel door; sixteen (16) gauge frame; metal wings for keying into construction; concealed hinges; screwdriver-operated stainless steel cam lock; shop-coated with one (1) coat of zinc chromate primer.

- E. Access panels shall not be installed in gypsum ceilings in public spaces.
- F. Valves above removable ceilings shall have tile clips by the Contractor for identification.

2.3 INSULATION

- A. The following system(s) shall be insulated:
 - 1. All domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.
 - 2. All domestic hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
 - 3. All horizontal storm drainage (primary) and overflow drainage (secondary) piping as well as roof drain bodies.
 - 4. All domestic water piping exposed to areas subject to freezing. Refer to Section 22 05 00, Subsection 2.4 "HEAT CABLE FOR FREEZE PROTECTION OF PIPING" for additional requirements and information.
- B. Domestic water, storm drainage, and waste drainage piping shall be insulated with four (4) lbs. density sectional fiberglass insulation. Insulation thermal conductivity k-value shall not exceed 0.24 and insulation shall have white "all service jacket" with vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with "all service jacket" three (3) inch wide tape. Insulation shall be used for exposed piping.
- C. Acceptable manufacturers:
 - 1. Johns Manville "Micro-Lok AP-T"
 - 2. Knauf "ASJ/SSL"
 - 3. Owens Corning "ASJ/SSL"
- D. Minimum requirements for piping system insulation and insulation thickness shall be as shown in the table below:

MINIMUM PIPE INSULATION			PIPE SIZE INSULATION THICKNESS (Ø)				
SYSTEM	FLUID TEMP RANGE		≤ 1"	1-1/4" – 2"	2-1/2" – 4"	5" and 6"	≥ 8"
	°C	°F	inch	inch	inch	inch	inch
Domestic cold water	ambient	ambient	0.5	1.0	1.0	1.0	-
Domestic hot water and hot water return	43.0 – 71.0	110.0 – 160.0	1.0	1.5	1.5	1.5	-
Sanitary waste above grade receiving condensate or ice machine discharge	4.5 – 15.5	40.0 – 60.0	0.5	1.0	1.0	1.5	-
Primary and secondary storm drainage	ambient	ambient	-	-	1.0	1.0	1.0

- E. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping with fiberglass insulation and with "all service jacket" protection. For exposed locations, provide one (1) inch thick rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow fitting and including all wye fittings, all the way to the change in direction at the vertical drop to below grade.

- F. Insulate all horizontal storm drainage piping and horizontal overflow drainage piping, including the roof drain bodies, with blanket-type glass fiber bonded thermosetting resin, white vinyl vapor retarding surface, and two (2) inch wide stapling/taping tab. Insulation shall be used in concealed spaces.
- G. Insulate all horizontal sanitary waste piping receiving air-conditioning condensate or ice machine discharge with minimum one (1) to one and one-half (1.5) inch fiberglass insulation with jacket. Begin from the floor drain, including the p-trap, and insulate all the way to the change in direction at the vertical drop to below grade.
- H. At natatoriums, including the pool equipment rooms, insulate all exposed plumbing piping with a complete aluminum jacketing system. Provide color-coded, printed pipe identification label ten (10) feet on center indicating pipe system type (e.g., storm drainage, domestic water, gas, etc.).
- I. Aluminum jacketing:
 - 1. Jacket for piping shall be 0.016 inches thick, type 3105 aluminum with factory-applied one (1) mil polykraft moisture barrier.
 - 2. Covers for fittings shall be 0.024 inches thick, type 1100 aluminum to match pipe covering.
 - 3. Aluminum jacketing shall be provided for all exposed piping.
 - 4. Acceptable manufacturers:
 - a. ITW Insulation Systems Pabco/Childers
 - b. RPR Products

2.4 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat cabling on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Acceptable manufacturers:
 - 1. Raychem
 - 2. Chromalox
 - 3. BriskHeat
 - 4. Thermon
- C. Provide Raychem XL-Trace or an approved, accepted manufacturer. Heat cable shall operate at five (5) watts per foot, 120VAC, and without the use of transformers. Provide the quantity of 120VAC branch circuits required to serve the entirety of the heat cable load at a maximum of 1800 watts per circuit.
- D. Installation shall consist of a complete system of Raychem RayClic connection kits, or an equal, accepted manufacturer, with a complete circuit that provides the required power connections, end seals, and controllers to ensure proper freeze protection. Splices, tees, and connection kits are used as required. Installation shall be as recommended by the manufacturer.
- E. Heat cable circuit shall be protected by a ground fault device for equipment protection. Provide this requirement in accordance with section 427.22 of the latest, applicable NEC.

- F. Provide a complete system of self-regulating heat cable on all domestic water piping in crawl spaces, un-conditioned attic spaces, outdoors, and any other locations subject to freezing. Heat cable, accessories, and controls to prevent systems from freezing shall be UL Listed, CSA Certified, or FM Approved. Heat cable component enclosures shall be NEMA 4X rated to prevent external water ingress and corrosion. Heat cable shall conform to all requirements as specified in the Contract Documents under Division 26 (Electrical).
- G. Heat cable shall be installed prior to insulation of the piping system and after all testing of the protected piping systems are complete. Heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc.
- H. Heat cable shall be capable of maintaining a minimum water temperature of 40°F at an ambient air temperature of 0°F.
- I. Heat cable shall be self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heating method shall not be acceptable.
- J. Provide an adjustable thermostat control which de-energizes the self-regulating heat cable when the ambient air temperature is above a set temperature. Default temperature setting of the thermostat control shall be set to de-energize when the ambient air temperature is above 40°F.
- K. Installation shall not require the installing Contractor to cut into the heating cable core to expose the bus wires. Systems whose connection methods require the installing Contractor to strip the bus wires, use crimps, or use terminal blocks shall not be acceptable.
- L. Provide all power connection hardware, splices, end seals, etc. to accomplish installation. All hardware shall be of the same manufacturer as the heat cable.
- M. Provide a minimum of one (1) inch thick fiberglass insulation on all piping with heat cabling.

2.5 HEAT CABLE FOR TEMPERATURE MAINTENANCE OF PIPING

- A. Provide electric heat cabling on all domestic hot water piping to maintain the temperature of the fluid in the piping downstream of the domestic hot water loop. Provide up to within twenty-four (24) inches of the fixtures being served to meet all the mandates of the energy efficiency codes per the City of Huffman.
- B. Acceptable manufacturers:
 - 1. Raychem
 - 2. Chromalox
 - 3. BriskHeat
 - 4. Thermon
- C. Provide Raychem HWAT-R2 with Raychem HWAT-ECO-GF controller or an equal, accepted manufacturer. Heat cable shall operate at 208VAC or 277VAC and without the use of transformers. Provide the quantity of 208VAC and 277VAC branch circuits required to serve the entirety of the heat cable load.
- D. Installation shall consist of a complete system of Raychem RayClic connection kits, or an equal, accepted manufacturer, with a complete circuit that provides the required power

connections, end seals, and controllers to ensure proper water temperature maintenance. Splices, tees, and connection kits are used as required. Installation shall be as recommended by the manufacturer.

- E. Heat cable circuit shall be protected by a ground fault device for equipment protection. Provide this requirement in accordance with section 427.22 of the latest, applicable NEC.
- F. Provide a complete system of self-regulating heat cable on all domestic hot water piping that is non-circulated. Heat cable, accessories, and controls to maintain water temperature shall be UL Listed, CSA Certified, or FM Approved. Heat cable component enclosures shall be NEMA 4X rated to prevent external water ingress and corrosion. Heat cable shall conform to all requirements as specified in the Contract Documents under Division 26 (Electrical).
- G. Heat cable shall be installed prior to insulation of the piping system and after all testing of the domestic hot water system is complete. Heat cable shall be installed linearly along the top of the pipe when passing through pipe hangers and at the four (4) or eight (8) o'clock position on linear runs. Affix the cable to the pipe every two (2) feet with Raychem AT-180 tape or an equal, accepted manufacturer. Heat cable shall not be compressed or pinched between two objects and allowance shall be made for all fittings, valves, pipe supports, etc.
- H. Penetrations through fire-rated assemblies shall have its own sleeve with fire resistant material equal to STI Firestop.
- I. Heat cable shall be capable of maintaining a minimum water temperature of 105°F and a maximum temperature of 140°F at an ambient air temperature of 50°F.
- J. Heat cable shall be self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core which varies its resistance continuously with changes in temperature. A constant wattage heating method shall not be acceptable.
- K. Provide an adjustable thermostat control which de-energizes the self-regulating heat cable when the ambient air temperature is above a set temperature. Default temperature setting of the thermostat control shall be set to de-energize when the ambient air temperature is above 100°F.
- L. Installation shall not require the installing Contractor to cut into the heating cable core to expose the bus wires. Systems whose connection methods require the installing Contractor to strip the bus wires, use crimps, or use terminal blocks shall not be acceptable.
- M. Provide all power connection hardware, splices, end seals, etc. to accomplish installation. All hardware shall be of the same manufacturer as the heat cable.
- N. Provide a minimum of one (1) inch thick fiberglass insulation for piping with heat cabling up to one (1) inch in diameter. For larger pipe sizes, refer to the manufacturer requirements and guidelines.

2.6 FLASHING

- A. Vent pipes passing through roof shall be flashed watertight.
- B. Roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.
- C. All vent piping shall be offset above ceilings or in attic spaces as required to penetrate roofs on the least-visible side(s) of the building.

2.7 FLOOR, WALL, AND CEILING PLATES

- A. Furnish and install heavy gauge, chromium-plated, steel wall and ceiling plates on all exposed pipes in finished areas where piping passes through walls, ceilings, etc.
- B. Plates shall be of the type that will remain permanently in position and, where pipes are insulated, they shall be of the size necessary to cover insulated piping.

2.8 DRAIN PAN

- A. Acceptable manufacturers:
 - 1. DiversiTech
 - 2. Killarney Metals
 - 3. Riverside Sheet Metal
- B. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan under all above grade plumbing piping in the electrical rooms, MDF rooms, and IDF rooms.
- C. Furnish and install eighteen (18) to twenty-four (24) gauge galvanized steel pan for water heaters.
- D. Drain pan shall have at least two (2) inches in depth and shall extend at least six (6) inches beyond the plumbing pipe or equipment.
- E. Drain pan shall be installed at least six (6) feet above electrical panels and electrical gear for accessibility and maintenance clearances and shall be installed within six (6) inches below the plumbing pipe or equipment.
- F. Provide steel strut channels and hangers for drain pan support.

2.9 TRACER WIRE

- A. All trace wire and trace wire components shall be domestically manufactured in the United States of America.
- B. All trace wire shall have HDPE insulation intended for direct bury and color-coded per APWA standards for the specific utility being marked.
- C. All trace wire shall be provided for underground, non-metallic system mains four (4) inches and larger.
 - 1. Trace wire shall be installed in the trench on top of the underground, non-metallic piping and then attached to a metal pipe above slab at the end of the run. The wire under Division 22 scope shall extend a maximum of five (5) feet outside the building exterior to an access point.
 - a. Access point shall be located such that it is easily accessible for maintenance personnel and in coordination with the surrounding Architectural and Civil elements.
- D. Acceptable manufacturers:
 - 1. Copperhead Industries
- E. Trace wire (copper-clad steel):

1. Open trench installation: direct burial 12AWG, solid steel core, soft drawn tracer wire with 250 lbs. average tensile break load, thirty (30) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 "TRACER WIRE EXECUTION" for additional requirements and information. Provide Copperhead Industries "1230-SF" or an equal, accepted manufacturer.
2. Directional bore or jacketed installation: direct burial 12AWG, solid steel core, hard drawn, extra high strength, horizontal directional drill tracer wire with 1,150 lbs. average tensile break load, forty-five (45) mil high-density polyethylene jacket complying with ASTM D1248, and thirty (30) volt rating. Refer to Section 22 05 00, Subsection 3.8 "TRACER WIRE EXECUTION" for additional requirements and information. Provide Copperhead Industries "1245-HS" or an equal, accepted manufacturer.

F. Connectors (copper-clad steel):

1. Splices along the continuous run of trace wire for repair of a wire break or replacement of a filed segment of wire shall use 3M "Direct Bury Splice Kits" or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting two or more wires, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.
2. Branch connections for laterals, turnouts, services, and appurtenances shall use King Innovation "DryConn" Waterproof Direct-Bury Lug Connectors (Aqua) or an equal, accepted manufacturer. Acceptable alternative products by other manufacturers shall be capable of securely connecting one or two wires to the main trace wire without cutting the main trace wire, effectively seal against moisture by means of a dielectric, non-hardening, silicone sealant, be approved for direct burial, and be rated for a minimum of fifty (50) volts.
 - a. The intent of this specification is to provide connection terminations at main branches serving separate buildings, separate sections of a building, turnouts, services, and appurtenances. The tracer wire shall be capable of continuing along all under slab main runs such that, when energized, the resulting tone continues for that part of the associated segment of the underground system.
3. Non-locking, friction fit, twist-on, and taped connectors shall not be acceptable. Twisting of copper wiring shall not be acceptable.

G. Termination and access (copper-clad steel):

1. Termination and access point shall be located a maximum of five (5) feet outside the building exterior. Provide Copperhead Industries "SnakePit" access point or equivalent product by alternative manufacturer that is compatible with the complete tracer wire system.
2. Terminal box shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.
3. Terminal box shall consist of tubular housing, terminal board, and removable round lid.

4. Minimum dimensions shall be five and one-half (5.5) inches diameter and eight (8) inches high. Base shall be sized to fit four (4) inch PVC Schedule 40 pipe.
 5. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of the construction shall be impervious to chemicals typically used for snow and ice removal as well as pavement and hardscape maintenance.
 6. Housing and lid shall be designed for easy access and maintenance:
 - a. Turf and landscape areas:
 - 1) Light-duty housing with plastic lid
 - b. Hardscape areas:
 - 1) Heavy-duty housing with cast iron or ductile iron lid
 - c. Roadway, driveway, and parking lot applications shall not be acceptable.
 7. Terminal board shall have nickel-plated brass terminals. Terminal quantity for necessary and complete installation of the system shall be provided as required with a minimum of four (4) spare terminals provided.
- H. Grounding (copper-clad steel):
1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of twenty (20) feet of 14AWG, red, HDPE insulated, copper-clad steel wire connected to the anode (minimum 0.5 lbs.) that is specifically manufactured for such applications and shall be buried at the same elevation as the utility.
 2. Drive-in magnesium anode shall be Copperhead Industries "ANO-1005" (1.5 lbs.) or an equal, accepted manufacturer.

2.10 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied to the piping systems below and as applicable to the scope of work installed under this Division:
1. Acid (vent, waste)
 2. Compressed air
 3. Condensate
 4. Deionized water (supply, return)
 5. Domestic water (cold, hot, hot return)
 6. Fuel (oil)
 7. Gas
 8. Heat trace
 9. Non-potable
 10. Sanitary (vent, waste)

11. Softened water
 12. Steam
 13. Storm drainage (primary, secondary)
 14. Vacuum
- B. Piping identification shall be applied to all piping systems in areas of exposed construction and in areas with accessible ceilings as well as in the following locations:
1. Both sides of each wall, floor, and ceiling penetration
 2. Connections to equipment
 3. Adjacent to valves and flanges
 4. Adjacent to piping obstructed from view
 5. Heat trace pipe runs at no more than ten (10) foot intervals or as required by the local code
 6. Straight pipe runs at no more than twenty-five (25) foot intervals
- C. Adhesive type labels shall not be acceptable, provide only “snap-around” or “snap-on” type labels.
- D. The letter size, background color, and placement of markers shall conform to the requirements of ANSI/ASME A13.1 as well as all OSHA requirements. Identify all interior exposed piping and all piping in chases or plenums with a plastic “snap-around” or “snap-on” label indicating pipe system type and direction of flow arrow. Contractor shall clean piping prior to plastic marker installation. Provide consistent manufacturer for plastic markers of each system such that marker background colors, arrows, and system description are visually identical. Each system shall be clearly identified with a minimum letter size of two and one-quarter (2.25) inches for pipe sizes up to four (4) inches and a minimum letter size of four (4) inches for pipe sizes larger than four (4) inches.
- E. Acceptable manufacturers:
1. Seton Nameplate Corporation
 2. Brady Corporation
- F. Each valve in the Division 21 and Division 22 systems shall be tagged with an individual number stamped onto the valve’s tag. Provide identification tags on all emergency fixtures and equipment shut-off valves.
- G. Valve tags shall be brass or plastic laminate, a minimum diameter of one and one-half (1.5) inches, and shall have a brass chain with hook for securing the valve tag to the valve.
- H. Valve tags shall include “P” or “FP” lettering designation to indicate the appropriate plumbing or fire protection system, respectively. Valve tag numbering shall be consecutive for each service of the plumbing or fire protection systems.
- I. Provide a printed, compiled list or schematic drawing for each system indicating the tagged locations as well as a detailed description of the system or equipment being served.

- J. Provide one (1) copy of each list or drawing that shall be framed and mounted at the location designated by the Building Engineer. Provide an additional copy of each list which shall be included in the O & M manual.

2.11 EQUIPMENT LABELING

- A. All equipment shall be labeled; this shall include all pumps, water heaters, storage tanks, compressors, water treatment systems, utility controllers, and other similar equipment.
- B. Equipment labeling shall be completed with the following items, unless noted or specified otherwise:
 - 1. Submit schedule of equipment to be included and their designations.
 - 2. Provide nameplates with one-half (0.5) inch high letters and fastened with epoxy or screws.

PART 3 – EXECUTION

3.1 OWNER INSTRUCTION – GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use O & M manuals and actual equipment installed as the basis for instruction.
- C. At conclusion of on-site training program, the Contractor shall have Owner personnel sign written certification that they have completed training and understand equipment operation. Include copy of training certificates in final O & M manual.
- D. No retainage shall be released until the Owner has received all O & M manuals and as-built drawings as well as performed a first O & M walk.
- E. Refer to individual equipment specifications for additional training requirements.

3.2 INSTRUCTION OF OWNER PERSONNEL

- A. Prior to final inspection, the Contractor shall conduct an on-site training program to instruct the Owner's operating personnel of the operation and maintenance for the installed plumbing systems.
 - 1. Provide the training during the Owner's regular working hours.
 - 2. The instructors shall each be experienced in their phase of operation and maintenance of building plumbing systems with the project.
- B. Time to be allocated for on-site training program:
 - 1. Minimum of eight (8) hours dedicated instructor time
 - 2. Minimum of four (4) hours per day for two (2) days
- C. Before proceeding with the on-site training program, the Contractor shall submit the program syllabus, proposed times and dates, and other pertinent information for review and approval by means of:
 - 1. One (1) copy to the Owner
 - 2. One (1) copy to the Architect
 - 3. One (1) copy to the Engineer

- D. The Owner will provide a list of personnel to receive instructions and will coordinate their attendance at the agreed upon times.
- E. Use the O & M manuals as the basis of instruction. Review contents of manual in detail with personal to explain all aspects of operation and maintenance.
- F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each equipment item.
- G. Demonstrate equipment functions both individually and as part of the total, integrated system.
- H. Prepare and insert additional data into the O & M manual when the need for additional data becomes apparent during instruction and training.
- I. Submit a report within one (1) week after completion of the on-site training program that demonstrations and instructions have been satisfactorily completed. Provide time, date, and hours devoted to each demonstration and instruction with a list of personnel in attendance.
- J. At the conclusion of the on-site training program, the Contractor shall have an Owner-designated individual sign a certificate to certify that they have a proper and thorough understanding of the demonstrated and instructed systems. By signing the certificate, the individual agrees that all demonstrations and instructions have been satisfactorily completed regarding the scope and content of the O & M manuals used in the on-site training program.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each O & M manual.

3.3 GENERAL REQUIREMENTS

- A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections required for a complete and satisfactory startup.
- B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed in such a manner and sequence as to avoid damage of components and as required by jobsite progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical, mechanical, technology, and architectural work. Equipment, accessories, and similar items requiring normal servicing or maintenance shall be easily accessible.
- C. The Engineer reserves the right to direct the removal of any item which, in their opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.4 STORAGE AND PROTECTION OF MATERIALS

- A. During construction, all equipment shall be properly protected against damage, defacing, and freezing with manufacturer supplied or recommended shipping cartons, plastic sheeting, shipping covers, etc.
- B. All open ends of piping and equipment shall be sealed with nipples, caps, plugs, and test plugs until final connection(s) to the system is made.

- C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with protective covers at the following instances:
 - 1. Floor sink opening: Protect and cover with heavy-duty plywood or heavy-duty plastic cover by SmartGuard.
 - 2. Floor drain opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 3. Cleanout opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 4. Pipe opening: Protect and cover with heavy-duty plastic cover by SmartGuard.
 - 5. Fixture opening(s): Protect and cover with plastic sheet cover until final punch list.
- D. Handle and store materials in accordance with the manufacturer and supplier recommendations and in a manner preventing damage to the materials during storage and handling. Replace all damaged materials.
- E. Equipment and materials shall not be installed until the environmental conditions of the jobsite are suitable to satisfactorily protect the equipment and materials. Equipment and materials damaged or subjected to adversarial environmental conditions shall not be acceptable and shall be removed from the jobsite and replaced accordingly.
- F. Use of duct tape or other similar protection methods shall not be acceptable.

3.5 DEMOLITION, REMOVAL, AND EXTENSION OF EXISTING PLUMBING WORK

- A. Disconnect plumbing and fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. During construction, provide all required connections to maintain operation of existing systems in service at the existing areas of the building(s) to remain.
- C. Maintain access to existing installations to remain active. Modify installation or provide access panels as required to accommodate existing installations remaining active.
- D. When performing work on operating systems, use personnel experienced and trained in similar systems.
- E. Remove, relocate, and extend existing installations to accommodate new construction.
- F. Remove all exposed and abandoned piping systems back to the source of supply, including abandoned systems above accessible ceilings. Cut systems flush with walls and floors, followed by patch and repairing affected surfaces as required.
- G. Extend existing installations to remain using materials and methods compatible with the existing installation, or as specified.
- H. Repair adjacent construction and finishes damaged during demolition and extension work as required.
- I. Normal facility activities shall continue in existing areas to remain in service. MEPT systems servicing existing occupied spaces shall have service maintained and uninterrupted. The Contractor shall schedule any required outages and system service interruptions with the Owner and Architect. Submit a written request indicating service(s)

and/or system(s) to be interrupted along with proposed duration and summary of work to be performed during downtime.

- J. For removed equipment and fixtures:
 - 1. Store items at jobsite. The Owner retains rights to all removed items.
 - 2. Allow the Owner ample time to review removed items and to designate which items shall be kept by the Owner.
 - 3. Dispose properly, off-site, all items the Owner chooses to relinquish.

3.6 REMOVAL OF EXISTING PLUMBING MATERIALS

- A. The Contractor shall modify, remove, and relocate all materials and items as indicated on the Drawings or as required by the installation of new facilities. All material removal and dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination shall be as directed by the Owner. Materials and items scheduled for relocation and that are damaged during dismantling and reassembling shall be repaired and restored to satisfactory and original operating conditions. The Contractor may, at their discretion and upon the approval of the Owner, substitute new materials and items of equal characteristics and quality in lieu of relocating materials and items.
- B. All items which are scheduled for relocation shall be carefully removed in reverse of the original assembly or placement and shall be protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore relocated items to satisfactory and original operating conditions. All relocations shall be performed by workmen skilled in the work being done and in accordance with standard practice of the trade(s) involved.
- C. When items scheduled for relocation are discovered to be in a damaged and irreparable condition before work to dismantle has begun, the Contractor shall bring such items to the attention of the Owner and shall wait to receive further instruction prior to removal. Items damaged during relocation shall be of the Contractor's responsibility and shall be repaired or replaced by the Contractor and as approved by the Owner. Such instances shall be at no additional cost to the Owner.
- D. Service lines to items to be removed, salvaged, or relocated shall be removed to the points indicated on the Drawings, as specified, or as acceptable to the Owner. Service lines not scheduled for reuse shall be removed to the points at which reuse continues or existing service is to remain. Such services shall be sealed, capped, or otherwise tied-off and disconnected in a safe manner that is acceptable to the Owner. All disconnections or connections from or into the existing facilities shall be done in a manner resulting in minimum interruption of services to adjacent, occupied areas. Services to existing areas and facilities which are to remain in operation during the construction period shall not be interrupted without prior and specific approval of the Owner as herein specified.
- E. Include in the contract price all rerouting of existing piping, fixtures, systems, etc. and all reconnections as necessitated by field conditions to allow the installation of the new item(s). Furnish all temporary piping, fixtures, systems, etc. as required to maintain plumbing services for the existing areas with minimal interruption.
- F. The Contractor shall bear responsibility for loss or damage to the existing facilities to remain and shall bear responsibility for repairing such loss or damage. The Contractor shall send proper notices, make the necessary arrangements, and perform other services required for the care, protection, and operational maintenance of all plumbing services for

the new and existing facilities. The Contractor shall erect temporary barricades with the necessary safety devices as required to protect personnel from injury and then removing all such temporary barricades upon completion of the work.

- G. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall coordinate the removal of doors, piping, fixtures, conduit, wiring, outlet boxes, ductwork, equipment, etc. to provide such access and shall reinstall removed items upon completion of work in the affected areas.
- H. Where partitions, walls, floors, and ceilings of existing construction are scheduled for removal, all Contractors shall coordinate the removal and reinstallation of such items in locations as approved by the Architect. The Contractors involved shall provide all devices required for the operation of the various systems installed in the existing construction.

3.7 EXCAVATION, TRENCHING, AND BACKFILLING

- A. The Contractor shall perform all excavation required to install the work specified herein and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the trench banks to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for the backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and excavated areas. Any water accumulation therein shall be removed via pumping. All excavation shall be made by open cut. Tunneling and boring shall not be acceptable except underneath pavement.
- B. The bottom of the trenches shall be graded to provide uniform bearing and supports for piping, fittings, etc. on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth and tamped in twelve (12) inch layers. Remove unstable soil that is not capable of supporting equipment or installation and replace with the specified material for a minimum of twelve (12) inches below invert elevation of the equipment or installation.
- C. The Contractor shall coordinate and provide pipe supports as required per structural Drawings for any void form system such as piping under the slab, piping exiting the building, special requirements on the backfill, etc. and as such all piping shall be supported by an approved, suspended system.
 - 1. System structure:
 - a. Provide a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system shall support the weight of suspended lateral pipes, including all imposed loads, throughout the construction process.
 - b. The system shall be designed to have the ability to temporarily position and suspend the lateral pipes to the specified height and slope until permanently anchored to the overhead structural slab via securing hanger system. The open, underground system then remains independent from the securing hangers.
 - c. The open space of the system beneath the structural slab is designed to receive infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will become separate and allow the lateral pipes to be totally independent from the system.

2. System components:
 - a. The system shall maintain its structural integrity in all humid environment conditions and shall have waterproof components appropriate for its intended performance. All system components, excluding all thread rods, nuts, and washers, shall be furnished by the system manufacturer.
 - b. All vertical all thread rods shall have a component secured toward the top end and permanently affixed into the concrete slab to maintain the specified elevations.
 - c. System shall be installed per the manufacturer's requirements and recommendations. The Contractor shall coordinate the system installation with the structural Drawings and the manufacturer guidelines as required.
- D. The trenches shall be backfilled with cement-stabilized sand materials approved for backfill purposes, deposited in six (6) inch layers, and tamped until the crown of the pipe is covered by a minimum of six (6) inches of material.
 1. Provide a sand-cement mixture producing a minimum unconfined compressive strength of one hundred (100) PSI in forty-eight (48) hours.
 - a. Design shall be based on strength specimens molded in accordance with ASTM D588 at a moisture content within three (3) percent of optimum and within four (4) hours of batching.
 - b. Determine minimum cement content from product data and statistical history. Provide no less than one and one-tenth (1.1) sacks of cement per ton of dry sand.
 2. Cement: Portland cement Type I conforming to ASTM C150
 3. Sand: Clean, durable sand meeting the grading requirements for fine aggregates of ASTM C33 and the following requirements:
 - a. Classified as SW, SP, SW-SM, SP-SM, or SM by the Unified Soil Classification System of ASTM D2487.
 - b. Deleterious materials:
 - 1) Organic impurities colored no darker than the standard color and conforming to the requirements ASTM C40.
 - 2) Lightweight pieces less than five (5) percent and conforming to the requirements of ASTM C123.
 - 3) Clay lumps less than one-half (0.5) percent and conforming to the requirements of ASTM C142.
 - c. Plasticity index of four (4) or less when tested in accordance with the requirements of ASTM D4318.
- E. Provide a layer of sand at least six (6) inches deep under all plastic pipe installed in soil. Bell end of pipe shall be excavated to ensure that the pipe rests for its entire length upon a solid trench bottom.
- F. The backfill under and beside the pipe shall be compacted for pipe support. The backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In

instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirements. The backfill process shall be carried out simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to ninety-five (95) percent of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water shall not be acceptable. Reopen any trenches not meeting compaction requirements or, where settlement occurs, the Contractor shall refill, compact, and restore the surface to the grade and compaction indicated as well as mounded over and smoothed off. A metallic-lined, underground warning tape shall be provided twelve (12) inches below finished grade. The warning tape shall be identifiable as to the type of line per OSHA and ANSI standard nomenclature and color.

- G. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.8 TRACER WIRE EXECUTION

- A. Trace wires shall be installed adjacent to nonmetallic underground water, gas, and main sewage lines underneath the building pad and stubbed up into a ground access well enclosure for the trace wire to connect to it. Trace wire shall be color coded for piping systems as follows:
 - 1. Natural gas: yellow
 - 2. Sanitary sewer: green
 - 3. Storm sewer: green
 - 4. Water (potable): blue
 - 5. Water (non-potable): purple
- B. Install trace wire as required by this Section and in accordance with the local codes:
 - 1. Trace wire shall be installed in the same trench as its associated piping and shall be installed inside bored holes and casing with pipe during pipe installation. Trace wire shall be secured to the pipe as required to ensure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved, watertight connector to provide electrical continuity and shall be accessible at all trace wire access points.
 - 2. Prior to backfill, install trace wire on top of pipe and secure in place with ties or hitches at a maximum of ten (10) foot intervals and in accordance with the local jurisdiction's water utility requirements. Run trace wire continuously along the pipe and terminate at access points. Where buried splices occur, use an approved electrical splicing kit only. Provide no less than twenty-four (24) inches of coiled wire at access points for attachment to pipe-locating equipment. Each installed pipe run shall be capable of being located using the trace wire system. Protect wire insulation from damage during installation and backfill. Wire insulation that is broken, cut, or damaged shall be replaced.
 - 3. At the point of connection between existing, conductive pipes, the trace wire shall not be connected to the conductive pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved, waterproof connection to a

grounding anode and buried at the same depth as the trace wire. All such connections points shall be grounded.

4. Where existing trace wire is encountered on an existing pipe run that is being extended or tied into, the new and existing trace wire shall be connected using approved splice connectors, shall be properly grounded at the splice location(s) as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
5. Trace wire shall be laid flat and securely affixed to the pipe at the three (3) o'clock position. The wire shall be protected from damage during execution of the work. No breaks or cuts in the trace wire or trace wire insulation shall be permitted. At service saddles, placing the trace wire between the saddle and the main shall not be acceptable.
6. At all main end caps, a minimum of six (6) feet of trace wire shall be extended beyond the end of the pipe, coiled, and secured to the cap for future connections. The end of the trace wire shall be spliced to the wire of a six (6) lbs. zinc anode and buried at the same elevation as the pipe main.
7. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valve boxes near pipe intersections, e.g., tees and crosses, may require more than one access point assembly in each concrete valve box collar.
8. At the point of connection between ductile iron water mains and any dissimilar material, the trace wire shall be properly connected to the iron pipe with a "Cadweld" or approved equivalent. Trace wire welds shall be completely sealed with the use of an approved, mastic-type sealer specifically manufactured for installation at below grade. Mastic shall be applied in a thick coat at a minimum of one-quarter (0.25) inch in thickness and shall be protected from contamination by the backfill material with the use of a plastic membrane.
9. Trace wire systems shall be installed as a single continuous wire except where approved connectors are used. Looping or coiling of the wire shall not be acceptable.
10. Any damage occurring during the installation of the trace wire shall be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping or spray coating shall not be acceptable.
11. Open trench installation:
 - a. Trace wire shall be placed a minimum of eight (8) inches above buried natural gas piping and nonmetallic piping for any service. For other utility piping systems, trace wire shall be laid directly upon pipe and attached at a maximum of ten (10) foot intervals with non-conductive tape. Additional attachment(s) shall be provided at offsets and fittings in the piping system. Trace wire shall be placed carefully, and great care shall be exercised during the backfill process to maintain physical integrity and position relative to piping.
 - b. Splices in trace wire shall be kept to an absolute minimum. When splices are necessary, they shall be made with approved trace wire connectors as specified. Other splicing methods shall not be acceptable.

12. Directional bore or jacketed installation:
 - a. Two (2) trace wires shall be provided with one (1) wire as backup.
 - b. Trace wires shall be pulled through bore hole(s) in conjunction with utility piping. Wires shall be located on opposite sides of utility piping.
 - c. Trace wire splices shall not be acceptable in drilled sections.
13. Trace wires shall be interconnected at intersections of mainlines and branches utilizing a single three-way connector at each point of connection.
14. A terminal box shall be provided at each building utility service entrance and shall be located above piping within five (5) feet of the point of entry into the building.
15. Terminal boxes shall not be located more than one thousand (1,000) linear feet of developed pipe length apart.
16. Terminal boxes shall not be installed at streets, drives, parking lots, or other areas subject to vehicular traffic.
17. Terminal boxes shall not be installed at areas where access to the box is impeded.
18. Terminal boxes shall be installed flush with finished grade and centered in grade-level concrete pads. Concrete pad shall be 18" X 18" minimum and shall be six (6) inches thick.
19. PVC pipe risers shall be firmly attached to the bottom of the terminal box housing and extended downward to an elevation approximately twelve (12) inches above piping. Riser shall serve as a vertical conduit for guiding trace wires into the bottom of the terminal box.
20. Care shall be taken to extend trace wire from utility pipe to the terminal box in an orderly and workmanlike manner as backfill is placed.
21. The end of each trace wire shall be properly landed on a dedicated terminal within the terminal box(es) and securely tightened. Twelve (12) to eighteen (18) inches of excess length shall be provided for each wire within a box. Each terminal shall be clearly identified with permanent labeling. Where trace wires for multiple utilities are terminated, care shall be taken to ensure accuracy of identification at both ends.

C. Testing:

1. All new trace wire installations shall be located using typical low frequency (512 hertz) line tracing equipment and witnessed by the Contractor, Engineer, and Owner's designated representative prior to acceptance of ownership.
2. The verification shall be performed upon completion of rough grading and again prior to final acceptance of ownership.
3. Final testing of each trace wire shall be performed after the backfill process is complete, terminal boxes have been permanently installed, and wires are terminated. Testing shall be witnessed by the Architect, Engineer, and Owner's designated representative. It may be advisable for the Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration.

Testing shall be accomplished using typical low frequency line tracing equipment. Continuity testing in lieu of actual line tracing shall not be acceptable.

- D. Perform all excavation and backfill work in accordance with the applicable portions of the earthwork sections of the code.

3.9 CONCRETE WORK

- A. Construct curbs, pads, vaults, and similar supports for equipment where required.
- B. First floor and equipment yard: provide a minimum of six (6) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment.
- C. Second floor and above: provide a minimum of four (4) inch thick housekeeping pads at floor mounted equipment and a minimum of four (4) inches larger than the entire area occupied by equipment. Dowel pads to the structural slab.
- D. Perform all concrete work in accordance with applicable portions of the concrete sections of the code. Minimum compressive strength of concrete shall be the same as specified for slabs on grade.

3.10 CLEANING OF PIPING SYSTEMS

- A. Provide cleaning of installed piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to completely clean, purge, and circulate the system as required.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, fixtures, etc. shall be thoroughly cleaned both inside and out with the following minimum requirements:
 - 1. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line-size blow down ball valve and pipe to nearest drain. Blow down, remove, and clean strainers as frequently as necessary.
 - 2. Phase I: Initial flushing of systems. Remove loose dirt, mill scale, weld beads, rust, and other deleterious substances without damage to the system components. Open valves, drains, vents, and strainers at all system levels during flushing procedures. Flush until potable water is clear and particles larger than five (5) microns are removed. Connect dead-end supply and return headers, even if not shown on the Drawings, and provide terminal drains in bottom of pipe end caps or blind flanges. Dispose of water in an approved manner.
 - 3. Phase II: Cleaning of piping systems. Remove, without chemical or mechanical damage to any system component, adherent dirt, organic soil, hydrocarbons, soldering flux, mill varnish, piping compounds, rust, and other deleterious substances not removed by initial flushing. Flush system and replace with clean, potable water.
 - 4. Phase III: Final flushing and rinsing of systems. Flush and rinse until potable water is clear and particles larger than five (5) microns are removed. Operate valves to dislodge any debris in the valve body. Dispose of water in an approved manner.
 - 5. Submit status reports upon completion of each phase of work on each system.

3.11 TESTING OF PIPING SYSTEMS

A. General:

1. Prior to insulation and concealment, all piping systems shall be subjected to testing with water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected.
2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's designated representative with a minimum of forty-eight (48) hours' notice given to the parties involved.
3. All equipment, material, labor, and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
4. All connected fixtures, equipment, accessories, etc. shall be isolated from the piping systems prior to testing.

B. Sanitary piping system:

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section enduring testing. All sections shall be tested with a minimum of ten (10) feet of head. In testing successive sections, at least the upper ten (10) feet of the next section shall be tested so that no piping joint in the building shall undergo a test consisting of less than ten (10) feet of head. The water shall be successfully kept in the system for at least thirty (30) minutes before inspection begins. The system shall then be made tight at all points.
2. Any point(s) of the drainage systems to be tested with air instead of water shall be performed by attaching a compressed air testing apparatus to any suitable opening and, after closing tight all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of five (5) PSI. This pressure shall be held without the introduction of additional air for a period of at least thirty (30) minutes.
3. Exterior connections shall be tested as part of the interior systems.

C. Interior water piping system:

1. Upon completion of the entire water supply system or a section of it as required, the system shall be tested prior to connection of fixtures, equipment, accessories, etc. and proved tight under a water or air pressure test of at least one hundred and fifty (150) PSI. Pressure shall hold for a period of one (1) hour without introducing additional water or air. Water used for testing shall be from a potable supply source. Defective joints or piping shall be replaced as required and all piping shall be retested as required.

D. Exterior water piping system:

1. All exterior domestic water piping shall be tested to one hundred and fifty (150) PSI for a period of two (2) hours.

E. Compressed air system:

1. All compressed air piping shall be tested to one hundred and fifty (150) PSI for a period of two (2) hours.
- F. Defective work:
1. If inspection or tests show defects, such defective work or material shall be replaced, and the inspections and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes shall not be acceptable.
- G. Additional tests:
1. Provide all additional tests such as smoke, pressure, etc. as required by the regulations or as directed by jurisdictional authorities making the inspection.
 2. Provide for any repeated test as directed by the Owner's designated representative to ensure all systems are tight as required.
 3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.12 OPERATING TESTS

- A. After all plumbing systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and performance through the range of its operations. Tests shall be made in the presence of the Architect and Engineer. Provide adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under their respective Specification Sections.
- B. Submit three (3) copies of all certifications and test reports in a timely manner ahead of work completion to allow adequate time for remedial action as required to correct deficiencies discovered in the equipment and plumbing systems.

3.13 DISINFECTION OF INTERIOR AND EXTERIOR WATER SYSTEMS

- A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.
- B. Whenever the authorities having jurisdiction do not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than fifty (50) parts per million of chlorine. The chlorinating solution shall be liquid chlorine of sodium hydrochloride solution and shall be introduced and drawn to all points in the system. The disinfecting solution shall be allowed to remain in the system for a period of eight (8) hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be thoroughly flushed from the system with clear, potable water until the residual chlorine content is no more than two-tenths (0.2) parts per million.
- C. This work shall be supervised or performed by an approved chemical testing laboratory and the results shall be sent to the Engineer or their representative for verification.

3.14 OPERATION AND MAINTENANCE MANUALS

- A. Form of manuals:
 1. Prepare data in the form of an instructional manual for use by the Owner's personnel.

2. Format:
 - a. Size: Letter size (8.5" X 11").
 - b. Text: Manufacturer's printed data or neatly typewritten equivalent.
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to be of at least the same format size as specified hereinbefore.
 4. Provide flyleaf indexed tabs for each separate product or each piece of operating equipment.
 5. Cover:
 - a. Identify each volume with the printed title, "Operating & Maintenance Instructions" and include the following elements:
 - 1) Title of project
 - 2) Identity of separate structures or facilities as applicable
 - 3) Identity of general subject matter covered in that specific volume
 6. Bind as specified.
- B. Content of manuals:
1. Provide a neatly typewritten table of contents for each volume, arranged in a systematic order as outlined in the Specifications, and include the following elements:
 - a. The Contractor name, name of responsible principal, address, and telephone number
 - b. Each product required to be included in the table of contents and indexed appropriately to the content of the volume
 - c. Each product's associated address, telephone number, and name of:
 - 1) The Subcontractor or installer
 - 2) Maintenance Contractor, if applicable
 - 3) Identify areas of responsibilities for each party
 - 4) Local source of part supplies and part replacement
 - d. Identify each product by the product name and other identifying symbols as set forth in the Contract Documents.
 2. Product data:
 - a. Include sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed

- 2) Identify data applicable to installation
 - 3) Delete references to inapplicable information
 - a) All options not supplied with equipment shall be marked out or indicated in some manner.
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems
 - 2) Controls and flow diagrams
 - b. Coordinate drawings with information in the Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use the Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for a specific installation, shall include:
 - a. Separate headings for different procedures and organized in a consistent format
 - b. Logical sequence of instructions for each procedure
 5. Copy each warranty, bond, and service contract issued.
 - a. Provide an information sheet for the Owner's personal indicating:
 - 1) Proper procedures in the event of failure
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings, and product data as specified.

C. Sections for equipment and systems:

 1. Content for each unit of equipment and system as applicable:
 - a. Description of unit and component parts:
 - 1) Function, normal operating characteristics, and limiting conditions
 - 2) Performance curves, engineering data, and tests
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Startup, break-in, routine, and normal operating instructions
 - 2) Regulation, control, stopping, and emergency shutdown instructions
 - 3) Summer and winter operating instructions
 - 4) Special operating instructions

- c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to troubleshooting
 - 3) Disassembly, repair, and reassembly
 - 4) Alignment, adjusting, and checking
 - 5) Routine service based on operation hours
 - d. Servicing and lubrication schedule as well as a list of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by the controls manufacturer.
 - g. Installed equipment and system control diagrams by the controls manufacturer.
 - h. Original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include:
 - 1) Predicted life of each part subject to wear
 - 2) Items recommended to be stocked as spare parts
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. Color-coded piping diagrams of the installed equipment and systems.
 - l. Charts of valve tag numbers with location and function of each valve.
 - m. Other data as required under relevant sections of the Specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in relevant sections of the Specifications.
 - 4. Provide complete information for products specified in Division 22.
 - 5. Provide certificates of compliance as specified in each related section of the Specifications.
 - 6. Provide startup reports as specified in each related section of the Specifications.
 - 7. Provide signed receipts for spare parts and materials.
 - 8. Provide training report and certificates.
 - 9. Provide backflow preventer certification test reports.
 - 10. Provide gas piping pressure test reports.

END OF SECTION 22 05 00

SECTION 22 05 10 – SANITARY PIPE TESTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.2 SUMMARY

- A. Acceptance testing of sanitary sewers including:
 - 1. Visual inspection of sewer pipes
 - 2. Leakage testing of sewer pipes
 - 3. Leakage testing of manholes, sampling wells, interceptors
 - 4. Television and video inspections
- B. All tests listed in this Section are not necessarily required in the project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.3 MEASUREMENT AND PAYMENT

- A. Unit prices:
 - 1. No payment shall be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
 - 2. Refer to related Section “MEASUREMENT AND PAYMENT” for unit price procedures.

1.4 REFERENCES

- A. ASTM C828 “Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines”
- B. ASTM C924 “Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method”
- C. ASTM C1244 “Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill”
- D. ASTM D3034 “Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings”
- E. ASTM F794 “Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter”
- F. ASTM F1417 “Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air”

1.5 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Product data:
 - 1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test plan:
 - 1. Prior to testing, and in adequate time to obtain approval through the submittal process, prepare and submit test plan for approval by the Project Manager. Include testing procedures, methods, equipment, and a tentative schedule. Obtain advance written approval for deviations from the Drawings and Specifications.
- D. Submit special procedures as required by the manufacturer's installation instructions.
- E. Submit test reports for each test on each segment of sanitary sewer piping.
- F. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 – General Requirements and each Specification Section.
- B. Project Record Documents:
 - 1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between cleanouts and pipe junctions.
- B. Systems shall meet the Texas Commission on Environmental Quality (TCEQ) testing requirements as defined in Section 217.57 "Testing Requirements for Installation of Gravity Collection System Pipes" and all testing requirements as required by local authorities having jurisdiction.
- C. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspections as directed by the Project Manager.

- E. Upon completion of video tape review by the Project Manager, the Contractor will be notified regarding the final acceptance of the sanitary sewer segment.

1.8 QUALIFICATIONS

- A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.
- B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.9 SEQUENCE AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing such that no more than one thousand (1,000) linear feet of installed sewer remains untested at any given time.
- B. Coordinate testing schedules with the Project Manager. Perform testing under the observation of the Project Manager.

1.10 WARRANTY

- A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

PART 2 – PRODUCTS

2.1 EXFILTRATION TEST

- A. Backflow preventer: provide a transient backflow preventer for when water used specifically for testing will be taken from the building system. Conform to local code requirements for type of backflow preventer and device application.
- B. Test equipment:
 - 1. Pipe plugs
 - 2. Pipe risers with ten (10) foot head of water (clear marked)

2.2 LOW PRESSURE AIR TEST

- A. Minimum requirements for equipment:
 - 1. Control panel
 - 2. Low pressure air supply connected to the control panel
 - 3. Pneumatic plugs: provide an acceptable size for the diameter of pipe to be tested and the plug shall be capable of withstanding internal test pressure without leaking or requiring external bracing.
 - 4. Air hoses from the control panel to the:
 - a. Air supply
 - b. Pneumatic plugs
 - c. Sealed line for pressuring
 - d. Sealed line for monitoring internal pressure

- B. Testing pneumatic plugs: place pneumatic plug in each end of pipe length on ground, pressurize plugs to twenty-five (25) PSIG, then pressurize sealed pipe to five (5) PSIG. Plugs are acceptable when they remain in place against test pressure without external aid.

2.3 SMOKE TESTING

- A. Test equipment:
 - 1. Pneumatic plugs
 - 2. Smoke generators as supplied by Superior Signal Company or an approved equal.
 - 3. Blowers producing two thousand and five hundred (2,500) SCFM minimum.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other devices necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps.
- C. If a cleanout or check valve has not been installed at the easement or property line, then the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation within five (5) feet of the foundation wall, then a cleanout shall be provided and installed.
- D. If the building lateral exits the foundation under an existing deck or concrete patio, then the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner and the Engineer.

3.2 VISUAL INSPECTION OF GRAVITY SYSTEM PIPES

- A. Check pipe alignment visually by flashing light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.
- B. Cut ten (10) foot section of pipe and inspect to determine the integrity of the pipe condition.

3.3 LEAKAGE TESTING FOR GRAVITY SYSTEM PIPES

- A. For a gravity system that will transport wastewater by gravity flow, test the gravity system pipes for leakage by either exfiltration or with low pressure air testing.
- B. Compensating for ground water pressure:
 - 1. Where ground water exists, install pipe nipple(s) at the same time the sewer line is placed. Use one-half (0.5) inch capped pipe nipple approximately ten (10) inches long. Make installation through the manhole wall on top of the sewer line where the line enters the manhole.
 - 2. Immediately before performing the line acceptance test, remove the cap, clear the pipe nipple with air pressure, and connect clear plastic tube to the nipple. Support the tube vertically and allow water to rise in the tube. After water stops rising,

measure the height in feet of water over invert of pipe. Divide this height by two and three-tenths (2.3) feet per PSI to determine ground water pressure to be used in line testing.

C. Drainage and vent water test:

1. Determine ground water elevation.
2. Plug sewer in the downstream manhole, cleanout, vent, or pipe stub as necessary.
3. Plug incoming pipes in the upstream manhole, cleanout, vent, or pipe stub as necessary.
4. Install riser pipe in the outgoing pipe of the upstream manhole when the highest point in the service lead (house service) is less than two (2) feet below the bottom of the manhole cone.
5. A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, then all openings in the piping shall be tightly closed, except the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, then each opening shall be tightly plugged, except the highest openings of the section under test, and each section shall be filled with water; additionally, no section shall be tested with less than ten (10) foot head of water. In testing successive sections, at least the upper ten (10) feet of the next preceding section shall be tested so that no joint or pipe in the building, except the uppermost ten (10) feet of the system, shall have been submitted to a test of less than ten (10) foot head of water. This pressure shall be held for not less than fifteen (15) minutes.

D. Drainage and vent air test:

1. Determine ground water elevation.
2. Plug sewer in the downstream manhole, cleanout, vent, or pipe stub as necessary.
3. Plug incoming pipes in the upstream manhole, cleanout, vent, or pipe stub as necessary.
4. Plastic piping shall not be tested using air. An air test shall be made by forcing air into the system until there is a uniform gauge pressure of five (5) PSI or sufficient to balance a ten (10) inch column of mercury. This pressure shall be held for a test period of not less than fifteen (15) minutes. Any adjustments to the test pressure required because of changes in ambient temperatures or the seating of gaskets shall be made prior to the beginning of the test period.

E. Drainage and vent final test:

1. The final test of the completed drainage and vent systems shall be visual and in sufficient detail to determine compliance with the provisions of the local codes. Where a smoke test is utilized, it shall be made by filling all traps with water and then introducing into the entire system a pungent, thick smoke produced by one (1) or more smoke machines as required. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a one (1) inch water column shall be held for a test period of not less than fifteen (15) minutes.

3.4 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.
- B. Prior to transmittal of corrected drawings, obtain three (3) sets of blue-line prints of each drawing, regardless of whether corrections were necessary, and include in the transmittal; two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each (reproducible Dayrex mylar film positives) and AutoCAD 2015 files on a compact disc (CD).
- C. As-built drawings should indicate the following information at a minimum:
 - 1. Indicate all changes to the Contract Documents.
 - 2. Remove Engineer's seal, name, address, and logo from the drawings.
 - 3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
 - 4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.
 - 5. Indicate all changes to construction during the construction process.
 - 6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
 - 7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.
 - 8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
 - 9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.
 - 10. Indicate all changes with clouding around said changes.

END OF SECTION 22 05 10

SECTION 22 05 12 – WATER PIPE TESTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Review these documents for coordination with additional requirements and information that apply to work under this Section.

1.2 SUMMARY

- A. Acceptance testing of domestic water including:
 - 1. Visual inspection of building piping systems
 - 2. Cleaning and flushing building piping systems
 - 3. Testing building piping systems
 - 4. Disinfecting building piping systems
 - 5. Placing building piping systems in operation
- B. All tests listed in this Section are not necessarily required in the project. Required tests are named in other Sections which refer to this Section for testing criteria and procedures.

1.3 MEASUREMENT AND PAYMENT

- A. Unit prices:
 - 1. No payment shall be made for acceptance testing under this Section. Include payment in unit price for work requiring acceptance testing.
 - 2. Refer to related Section “MEASUREMENT AND PAYMENT” for unit price procedures.

1.4 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard is the current edition at the time of commencement of the work.
 - 3. Refer to Division 01 – General Requirements for the list of applicable regulatory requirements.
 - 4. Refer to Division 22 – Common Work Results for Plumbing for codes, standards, and other general requirements.
- B. American Water Works Association (AWWA) C651 “Disinfecting Water Mains”

- C. Code of Federal Regulations (CFR) Title 29, Part 1910 "Occupational Safety and Health Standards"
- D. Compressed Gas Association (CGA) G-4.1 "Cleaning of Equipment for Oxygen Service"
- E. Factory Mutual (FM) "Global Property Loss Prevention Data Sheets"
- F. International Association of Plumbing and Mechanical Officials (IAPMO) "Uniform Plumbing Code"
- G. International Code Council (ICC) "International Plumbing Code"

1.5 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Product data:
 - 1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
- C. Test plan:
 - 1. Prior to testing, and in adequate time to obtain approval through the submittal process, prepare and submit test plan for approval by the Project Manager. Include testing procedures, methods, equipment, and a tentative schedule. Obtain advance written approval for deviations from the Drawings and Specifications.
- D. Submit special procedures as required by the manufacturer's installation instructions.
- E. Submit test reports for each test on each segment of sanitary sewer piping.
- F. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 – General Requirements and each Specification Section.
- B. Project Record Documents:
 - 1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Water to be discharged from flushing and disinfecting procedures shall be neutralized and disposed of in accordance with Division 01 or Division 33.
- B. The purpose of these procedures is to ensure that pressure tests are conducted safely and effectively. They cover pressure testing of new and existing pressure systems or components at a test pressure of more than zero (0) PSIG. They apply to mechanics, supervisors, inspectors, custodians, and subcontractors responsible for pressure tests.
- C. Repair, correct, and retest sections of pipe which fail to meet specified requirements when tested.
- D. Provide testing reports and video tape of television inspections as directed by the Project Manager.
- E. Upon completion of video tape review by the Project Manager, the Contractor will be notified regarding the final acceptance of the sanitary sewer segment.

1.8 QUALIFICATIONS

- A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.
- B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.9 SEQUENCE AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing such that no more than one thousand (1,000) linear feet of installed domestic water piping remains untested at any given time.
- B. Coordinate testing schedules with the Project Manager. Perform testing under the observation of the Project Manager.

1.10 WARRANTY

- A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Provide test equipment at the piping connections between the pipe tested and the water source.
- B. Provide equipment, materials, and facilities required to perform specified tests including, but not limited to, the following:
 - 1. Pumping equipment
 - 2. Calibrated water meter (within six (6) months)
 - 3. Calibrated pressure gauges (within six (6) months)
- C. Sectionalizing devices required including, but not limited to, the following:
 - 1. Flanges

2. Valves
3. Bulkheads
4. Bracing
5. Blocking

PART 3 – EXECUTION

3.1 CLEANING AND FLUSHING

A. Water piping systems:

1. After completion of all work in each section of the various water piping systems and prior to testing, flush all piping to remove foreign materials and to thoroughly clean the system. Flushing shall be continued until the water leaving the system is clear and acceptable to the Owner and Engineer; however, in no case shall the flushing be performed for less than ten (10) minutes.
2. Ensure that adequate quantities of water are available to produce a flushing velocity of not less than two and one-half (2.5) feet per second.

3.2 HYDROSTATIC PRESSURE TEST

A. General:

1. Prior to acceptance and initial operation, inspect and test the piping systems to ensure that the design, materials, fabrication, and installation are in accordance with these specifications.
2. Test piping prior to being enclosed, covered-up, or treated externally with insulation, tape wrapping, mastic coating, and similar treatments.
3. Notify the Owner and Engineer at least forty-eight (48) hours prior to testing and conduct tests in the presence of the Owner's designated representative.
4. Piping systems shall show no pressure loss, unless noted otherwise, while being tested in accordance with this Section of these Specifications. When leakage or other defects are located, repair or replace the affected portion of the piping system and retest. In the event any repairs, replacements, or additions are made to the system following the pressure test, the Contractor shall retest the affected piping. In the case of very minor repairs, replacements, or additions made to the system following the pressure test, the Owner and Engineer at their sole discretion may omit retesting provided that precautionary measures are taken to assure sound construction.

B. General test procedures:

1. All valves shall be in the fully open position during the test. Do not include any components (gauges, relief vales, instrumentation, and similar items) as part of the tests that are not rated for the testing pressure.
2. Remove all persons not directly involved with the test from the immediate test area.
3. Remove pressure relief valves or non-reclosing relief devices from the vessel; or test boundaries where the test pressure will exceed the set pressure of the valve;

or hold down each valve by means of an appropriate test clamp and pressurize both sides of the non-reclosing relief devices. Install temporary, higher-rated devices where practical.

4. Install the calibrated test gauge so it is always visible.
5. Pressurize the system by raising the pressure in the system gradually until the designed test pressure is achieved.
6. Do not attempt to modify a piping system when it is pressurized, including tightening leaking joints. Do not repair, replace, or retighten leaking joints or components until the pressure has been reduced to ambient level.
7. Measure test pressure with a manometer or with a pressure-measuring device designed and calibrated to read, record, or indicate the maximum test pressure. Record any pressure loss due to leakage during the pressure test period while the system is pressurized but isolated from the pressure source.
8. In general, test nonhazardous liquid, inert gas, and compressed air systems at a minimum of one hundred and fifty (150) percent of the working pressure in the line. The test pressure for each piping system shall be not less than the following values, irrespective of the design maximum allowable working pressure (MAWP):

PIPE TESTING REQUIREMENTS			
TEST SYSTEM	TEST PRESSURE	TEST MEDIA	TEST DURATION
	<i>PSIG</i>		<i>hours</i>
Domestic cold and hot water	225	Domestic cold water	24

9. Prepare test records of inspection and all tests performed. Indicate which portions of the piping system are in accordance with these Specifications. Briefly document test procedures, instruments and media used, and test pressures. Before requesting final approval of a piping installation, submit copies of test records for approval by the Owner and Engineer.

3.3 DISINFECTING DOMESTIC WATER PIPING SYSTEM

A. General:

1. Clean and disinfect all cold water systems in accordance with AWWA C651 "Disinfecting Water Mains" when the project is complete and when, by test, the system is proven to be free from leaks and ready for use.

B. Disinfecting procedure:

1. Connect the injection hose to the test connection.
2. With the system completely full of water and the supply valve open, proceed to adjust every valve of the system so that a trickle of water flows from each.
3. Inject the disinfectant slowly, at a uniform rate, until an orthotolidine test at each outlet shows a minimum chlorine residual concentration of one hundred (100) parts per million.

4. Close all outlets and valves, including the valve connecting to the water supply line and the three-quarters (0.75) inch service cock on the solution-injection connection.
 5. Maintain the condition for twenty-four (24) hours. If, after the allotted time, the orthotolidine tests indicate that the chlorine residual concentration has decreased below fifty (50) parts per million, then repeat the disinfecting procedure until an approved result is obtained.
 6. When the residual chlorine requirements have been fulfilled, the portion of the water system being disinfected shall be drained and flushed until the chlorine concentration of the discharged water has been reduced to an amount equivalent to the level normally present in the water supplied to the area. This portion of the system shall again be isolated by valving off said portion of the system. All drainage and flushing water shall be directed to the sanitary sewer system.
 7. After checking that the residual chlorine concentration is not greater than control levels using the orthotolidine test, the Contractor shall take water samples after a twenty-four (24) hour incubation period at predetermined locations of the isolated system. The sampling points shall be chosen to provide accurate information regarding the bacteriological quality of the water. Before putting this system into service, the results of these tests must show the water to be completely free (i.e., less than one (1) or none detected) from coliform organisms after the allotted time for the incubation period.
 8. If the results of the bacteriological tests do not meet the standard specified above, the disinfection procedures shall be repeated until this standard is satisfied.
 9. Tie-in fittings to be replaced in existing mains shall be sterilized either by immersing in a chlorine solution of five hundred (500) parts per million for one-half (0.5) of an hour or by swabbing with five (5) percent hypochlorite solution.
 10. On systems where a riser is to be directly connected to an existing underground link that has been previously sterilized and terminates above ground, the double check valves, test cocks, and all piping and fittings between the check valves and the termination of the underground line are to be immersed in a five hundred (500) parts per million chlorine solution for one (1) hour prior to assembly. The termination of the underground line shall not be left uncovered any longer than necessary. The sterilization process shall be monitored by the Owner, Engineer, Inspector, and a designated representative from Berkeley Lab EH&S.
 11. Bennett Marine Utility shall issue a sterilization and chlorination certificate to the Subcontractor to demonstrate satisfactory completion of the above procedure. The Subcontractor shall submit the certificate to Berkeley Lab EH&S for their review.
- C. Disinfecting agent: The Subcontractor shall supply the disinfecting agent; supply the injecting apparatus; inject the disinfecting agent into the system; operate the valves.
- D. Preparation:
1. Provide a test connection for the system to be disinfected within two (2) to three (3) feet of its junction with the water supply lines for injecting the disinfectant into the system.
 2. Prepare the water flow valves for sterilization.

3. Thoroughly flush the system by fully opening every outlet and operating every fixture until clear water flows from all outlets.

3.4 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other devices necessary for proper testing and inspection.
- B. Isolate each floor or section being tested by inserting plugs into the test tees in the stacks. Plug or cap all other openings with test plugs or test caps.
- C. If a cleanout or check valve has not been installed at the easement or property line, then the cleanout or check valve shall be installed prior to testing. If there is no cleanout located outside the building foundation within five (5) feet of the foundation wall, then a cleanout shall be provided and installed.
- D. If the building lateral exits the foundation under an existing deck or concrete patio, then the location of the building cleanout near the foundation may be modified on a case-by-case basis as determined by the Owner and the Engineer.

3.5 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes indicating actual, final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of one-eighth (0.125) inch scale.
- B. Prior to transmittal of corrected drawings, obtain three (3) sets of blue-line prints of each drawing, regardless of whether corrections were necessary, and include in the transmittal; two (2) sets are for the Owner's use and one (1) set is for the Architect/Engineer's records. Delivery of these as-built prints and reproducibility is a condition of final acceptance. Provide as-built drawings of one (1) set each (reproducible Dayrex mylar film positives) and AutoCAD 2015 files on a compact disc (CD).
- C. As-built drawings should indicate the following information at a minimum:
 1. Indicate all changes to the Contract Documents.
 2. Remove Engineer's seal, name, address, and logo from the drawings.
 3. Mark and indicate these are "AS-BUILT DRAWINGS" on the documents.
 4. Mark and indicate "DOCUMENT PRODUCED BY" followed with the responsible Contractor's relevant information.
 5. Indicate all changes to construction during the construction process.
 6. Indicate actual routing of all piping, ductwork, etc., that deviated from the Contract Documents.
 7. Indicate exact locations of all below grade plumbing piping and their respective flow line elevations.

8. Correct equipment schedules to reflect actual equipment furnished and their respective manufacturer, make, and model.
9. During the execution of work, maintain a complete set of drawings and specifications where all locations of equipment, ductwork, piping, devices, and all deviations and changes from the Contract Documents in the work shall be recorded.
10. Indicate all changes with clouding around said changes.

END OF SECTION 22 05 12

SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Expansion joints
 - 2. Pipe alignment guides
 - 3. Pipe anchors
- B. Related Sections:
 - 1. 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
 - a. Product and installation requirements for piping hangers and supports.

1.3 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints shall adequately provide protection of the system.
- B. Expansion compensation design criteria:
 - 1. Installation temperature: fifty (50) degrees Fahrenheit
 - 2. Domestic hot water: one hundred and forty (140) degrees Fahrenheit
 - 3. Safety factor: thirty (30) percent

1.4 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Shop drawings: indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered Professional Engineer.
- C. Product data:
 - 1. Flexible pipe connectors: indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion joints: indicate maximum temperature, pressure rating, and expansion compensation.

- D. Submit calculations of the design data indicating calculation criteria and sealed by a registered Professional Engineer.
- E. Submit special procedures as required by the manufacturer's installation instructions.
- F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.
- G. Submit welders' certificate indicating compliance with all American Welding Society (AWS) D1.1 "Structural Welding Code – Steel Endorsement Description" requirements.
- H. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.
- I. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.5 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 01 – General Requirements and each Specification Section.
- B. Project Record Documents:
 - 1. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- C. Submit adjustment instructions as required by the equipment or system operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with ASME B31.9 "Building Services Piping" for installation of piping systems and ASME BPVC-IX "Welding, Brazing, and Fusing Qualifications" for welding materials and procedures.

1.7 QUALIFICATIONS

- A. Installer: the company must specialize in performing work of this Section with a minimum of three (3) years of documented experience.
- B. Design expansion compensating systems under the direct supervision of a Professional Engineer experienced in design of this work and licensed at the location of the jobsite.

1.8 WARRANTY

- A. Furnish a five (5) year manufacturer warranty for leak-free performance of packed expansion joints.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints onsite in factory packing with shipping bars and positioning devices intact. Inspect for damage.

- B. Protect equipment from exposure by leaving factory coverings, pipe end protections, and packaging in place until installation.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. necessary for the work required shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the manufacturer-intended use and shall be subject to approval by the Engineer.
- B. All equipment, products, and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment, products, and materials for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.

2.2 EXPANSION JOINTS

- A. Acceptable manufacturers:
 - 1. VMC/Amber Booth
 - 2. Triplex
 - 3. Mason Industries
 - 4. Uponor
- B. Stainless steel bellows type:
 - 1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
 - 2. Maximum compression: one and three-quarters (1.75) inch
 - 3. Maximum extension: one-quarter (0.75) inch
 - 4. Joint: provide as specified for pipe joints
 - 5. Size: provide as per pipe size
 - 6. Application: steel piping three (3) inches and smaller
- C. External ring controlled stainless steel bellows type:
 - 1. Pressure rating of two hundred (200) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit; for use with water, oil, gas
 - 2. Maximum compression: fifteen-sixteenths (0.9375) inch
 - 3. Maximum extension: five-sixteenths (0.3125) inch
 - 4. Maximum offset: one-eighth (0.125) inch
 - 5. Joint: flanged
 - 6. Size: provide as per pipe size

7. Accessories: internal flow liner
 8. Application: steel piping three (3) inches and larger
- D. Double sphere flexible type:
1. Construction: multi-layered Kevlar tire cord fabric reinforced with peroxide-cured EPDM cover, liner, and fabric frictioning
 2. Pressure rating of two hundred and fifteen (215) PSIG; temperature rating of two hundred and fifty (250) degrees Fahrenheit
 3. Maximum compression: one and one-quarter (1.25) inch permissible compression for up to six (6) inch pipe size; one and one-half (1.5) inch permissible compression for eight (8) inch pipe size and up to twelve (12) inch pipe size; one and one-fifth (1.2) inch permissible compression for fourteen (14) inch pipe size.
 4. Maximum elongation: three-quarters (0.75) inch permissible elongation for up to six (6) inch pipe size; one and one-half (1.5) inch permissible elongation for eight (8) inch pipe size and up to twelve (12) inch pipe size; five-eighths (0.625) inch permissible elongation for fourteen (14) inch pipe size.
 5. Maximum offset: three-eighths (0.375) inch permissible offset for up to six (6) inch pipe size; seven-eighths (0.875) inch permissible offset for eight (8) inch pipe size and up to twelve (12) inch pipe size; one (1) inch permissible offset for fourteen (14) inch pipe size.
 6. Maximum angular movement: fifteen (15) degrees
 7. Joint: steel or ductile iron flanges
 8. Size: provide as per pipe size
 9. Accessories: control rods
 10. Application: steel piping three (2) inches and larger
- E. PEX-a pipe support:
1. For use with Uponor PEX-a pipe
 2. Continuously support PEX-a piping with manufacturer approved pipe support systems and utilize fixed anchor points every:
 - a. Sixty-five (65) feet for domestic hot water
 - b. One hundred and fifty (150) feet for domestic cold water
 3. Utilize manufacturer-provided stainless steel straps to secure the PEX-a pipe supports to the pipe at the intervals specified in the manufacturer's installation instructions.
 4. Refer to the Uponor "Plumbing Design Assistance Manual" (PDAM) for more information.

2.3 ACCESSORIES

- A. Acceptable manufacturers:

1. VMC/Amber Booth
 2. Triplex
 3. Mason Industries
- B. Pipe alignment guides: two-piece welded steel, bolted, with enamel paint and with spider to fit standard pipe; frame with four mounting holes; clearance for minimum of one (1) inch thick insulation; minimum of three (3) inches for travel.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Examine piping layout and notify the Architect and Engineer of additional anchors or expansion joints required to adequately protect the system.
- B. Provide inspection services by the flexible pipe manufacturer's designated representative for final install and certify that the installation is in accordance with the manufacturer's recommendations as well as that the connectors are performing satisfactorily.

3.2 INSTALLATION

- A. Install work in accordance with ASME B31.9 "Building Services Piping" and any applicable local codes.
- B. Install piping to allow for expansion and contraction without stressing piping, joints, or connected equipment.
- C. Flexible piping shall not be used in concealed spaces. Access panels shall be provided for concealed space installations.
- D. Provide supports and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints or expansion joints where required. Refer to Section 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT for pipe hanger installation requirements.
- E. Provide grooved piping systems with a minimum of one (1) joint per inch of pipe diameter instead of flexible connectors supported by vibration isolation. Grooved piping systems need not be anchored.
- F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to the isolated equipment and anchor the other end.
- G. Provide expansion loops as per the pipe manufacturer's design guidelines or as indicated on the Drawings. Rigidly anchor pipe to the building structure where necessary and as required. Provide pipe guides so that movement takes place along the pipe's axis only. Rigidly anchor pipe to the building structure to prevent stress, strain, and loading transfer to connected equipment.
- H. Coordinate with the installation of piping seismic braces so that they do not interfere with thermal expansion loop action or building joint loop action.
- I. Install expansion compensating devices for PEX-a piping in accordance with the manufacturer's installation instructions.

END OF SECTION 22 05 16

SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. Erico Caddy.
 - 3. PHP System.
 - 4. Anvil/Anvil Strut.
 - 5. BLINE.
- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - a. Provide at all system stub-ups from below grade thru ground floor slab.
 - 8. Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 9. Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 10. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 11. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 - 12. Non-metallic pipe support: Vinyl-coated Hangers.
 - 13. PEX Tube Support: CTS sized hangers or supports free of sharp edges.
 - 14. Galvanized steel to be used for outdoor installation.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Provide locking nuts on all rod extensions.
- C. Galvanized steel to be used for outdoor installation.

2.3 INSERTS

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.
- K. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.

- 4. Plywood or particle board.
- 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.

- B. Supports for Gas Piping:
1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Supports for Cast Iron Piping:
1. Vertical Piping:
 - a. Support vertical piping and tubing at base and at each floor.
 - b. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers should be used for this purpose.
 - c. When vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.
 2. Horizontal Piping, Suspended:
 - a. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint.
 - b. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
 - c. Provide hangers as necessary to provide alignment and grade. Provide hangers at each horizontal branch connection. Adequate provision should be made to prevent shear. Where pipe and fittings are suspended in excess of eighteen inches by means of non-rigid hangers, a sway bracing to be provided.
 - d. An anchor or bracing to be provided on all storm drain pipe fittings.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment.
 5. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
 6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 8. Support riser piping independently of connected horizontal piping.
- D. Supports for copper tubing:
1. The following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

- e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod
 - 2. Install supports for vertical copper tubing every 10 feet (3 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- E. Supports for steel piping:
- 1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 - 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- F. Supports for stainless-steel piping:
- 1. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 - 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 - 3. Support vertical piping and tubing at base and at each floor.
- G. Supports for CPVC piping:
- 1. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.

- e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
- H. Supports for PEX tubing:
 1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod. Or
 - b. 3/4" and smaller: 72 inches when a continuous support channel is used.
 - c. 1" and larger: 96 inches when a continuous support channel is used.
 2. Support vertical piping and tubing at base and at each floor.
 3. Install hangers for vertical PEX piping every 48 inches (1200 mm).
 4. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.
- I. Supports for PVC piping:
 1. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PVC piping every 48 inches (1200 mm).
 3. Support vertical piping and tubing at base and at each floor.
- J. Supports for PP piping:
 1. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
 4. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

- K. Supports for insulated piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- L. Supports for Vertical-Piping
 - 1. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- M. Design hangers for pipe movement without disengagement of supported pipe.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- O. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries, such as grade beam, basement wall, sump wall etc.: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.

- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 22 05 29

SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- C. 22 05 00 – COMMON WORK RESULTS FOR PLUMBING
- D. 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- E. 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- F. 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- G. 22 20 23 – GAS PIPING

1.2 SUMMARY

- A. It is the intent of this Section to provide vibration isolation supports for all equipment and piping as it may be required to prevent transmission of vibration to the building structure. It shall be the Contractor's responsibility to select and install vibration isolators which shall meet the specified noise criteria standards to the extent that the noise can be controlled by the vibration isolators.

1.3 REFERENCES

- A. International Code Council (ICC) "International Building Code"

1.4 PERFORMANCE REQUIREMENTS

- A. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- B. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of one-half (0.5) horsepower and larger. Deflections as tabulated are minimums and it shall be the vibration isolator manufacturer's responsibility to determine the amount of spring deflection required for each isolator to achieve optimal performance in preventing transmission of objectionable vibrations and in meeting the noise criteria standards referenced herein.
- C. Unless otherwise noted, equipment driven by motors one-quarter (0.25) horsepower and smaller shall be isolated by means of type "ND" elastomeric mounts or type "HD" elastomeric hangers properly sized for seven-twentieths (0.35) inch deflection.
- D. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and antioxidant additives.
- E. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and

washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

- F. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of thirty (30) pounds per square foot. Wind loads shall be applied to all exposed surfaces of the isolated equipment to identify worst-case scenario loads.
- G. All spring isolators shall be completely stable in operation and shall be designed for not less than fifty (50) percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a K_x and K_y anisotropic ratio of at least 1:1.
- H. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory-certified data. Any variance or non-compliance with these Specification requirements shall be corrected by the Contractor at no additional cost to the Owner. The manufacturer may purchase other manufactured products to meet this Specification and shall guarantee outsourced products as a single point of responsibility. Outsourced products shall be identified as such in the submittal for approval.
- I. The Contactor and manufacturer of the isolation devices and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- J. Deflection information is based on maintaining rooms at the following maximum sound levels, denominated in Noise Criteria (NC) as defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the American National Standards Institute (ANSI) S1.8 "Reference Values for Levels used in Acoustics and Vibrations" requirements.

RECOMMENDED NOISE CRITERION			
CATEGORY	TYPE OF ROOM	NOISE CRITERION LEVEL	EQUIVALENT SOUND LEVEL
		NC	dB_A
Offices	Conference rooms	25 – 30	35 – 40
Offices	Private	30 – 35	40 – 45
Offices	Open-plan areas	35 – 40	45 – 50
Offices	Business machines, computers	40 – 45	50 – 55
Offices	Circulation	35 – 40	45 – 50
Schools	Lecture and classrooms	25 – 30	35 – 40
Schools	Open-plan classrooms	35 – 40	45 – 50
Libraries	Libraries	35 – 40	40 – 50
Theaters	Theater	20 – 25	30 – 35
Theaters	Stage house	20 – 25	30 – 35
Theaters	Trap room	20 – 25	30 – 35
Theaters	Orchestra pit	20 – 25	30 – 35
Theaters	Rehearsal rooms	20 – 25	30 – 35
Theaters	Teaching studios	25 – 30	35 – 40
Theaters	Practice rooms	25 – 30	35 – 40
Theaters	Ensemble rooms	25 – 30	35 – 40
Theaters	Set shop	40 – 45	50 – 55

1.5 SUBMITTALS

- A. Provide a specification review that consists of a copy of the related specification section with notations indicating compliance or deviation with each element of the specification section.
- B. Shop drawings: indicate inertia bases and locate vibration isolators with static and dynamic loads annotated on each instance. Indicate assembly, materials, thicknesses, dimensional data, layouts, and connection details. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Product data:
 - 1. Submit schedule of vibration isolator types with locations and loads on each instance. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Submit calculations of the design data indicating maximum room sound levels are not exceeded.
- E. Submit special procedures as required by the manufacturer's installation instructions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Submit manufacturer's certificate indicating the submitted products meet or exceed the specified requirements.
- G. Submit manufacturer's field reports indicating results of inspection by the manufacturer's designated representative.
- H. Review of the submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

1.6 QUALITY ASSURANCE

- A. Testing agency qualifications: independent agency with the experience and capability to conduct the testing indicated. Agency shall be certified as a Nationally Recognized Test Laboratory (NTRL) as defined by Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910.7 "Definition and Requirements for a Nationally Recognized Testing Laboratory" as well as certified by the local authorities having jurisdiction.
- B. Welding qualifications: qualify procedures and personnel according to American Welding Society (AWS) D1.1/D1.1M "Structural Welding Code – Steel" requirements.
- C. All plumbing systems' vibration and sound control products shall conform to ASHRAE criteria for average noise criteria curves for all equipment at full load conditions.

PART 2 – PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

- A. All vibration isolators described in this Section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Section 22 05 48.13, Subsection 1.4 "PERFORMANCE REQUIREMENTS" and the information below.
- B. Acceptable manufacturers:
 - 1. VMC/Amber Booth
 - 2. Mason Industries
 - 3. Kinetics Noise Control
 - 4. Vibration Eliminator Company
- C. Type "WSW"
 - 1. Two (2) layers of three-eighths (0.375) inch thick neoprene pad consisting of square waffle modules separated horizontally by a sixteen (16) gauge galvanized shim. Where the load bearing area of the equipment is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of three twenty-fifths (0.12) inch up to four twenty-fifths (0.16) inch.
- D. Type "ND"
 - 1. Neoprene mountings shall have minimum static deflection of seven-twentieths (0.35) inch. All metal surfaces shall be neoprene covered and have friction pads at both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment, such as small vent sets, to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size and shape as the load bearing area of the pad and load distribution plates, a galvanized steel sheet of one-quarter (0.25) inch minimum thickness shall be utilized to ensure the load bearing capacity of the pad is maximized.
- E. Type "SLF"
 - 1. Spring isolators shall be free-standing and laterally stable without any housing and complete with a molded neoprene cup or one-quarter (0.25) inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed height and operating height shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than four-fifths (0.8). Springs shall have minimum additional travel to solid equal to fifty (50) percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height, and solid spring height.
- F. Type "SLR"
 - 1. Restrained spring mountings shall have an "SLF" mounting as described in Subsection 2.1.E "Type 'SLF'" and within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment.

Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and the spring to avoid interference with any spring action. Limit stops shall be out of contact during normal operation. Since housings are bolted or welded in position under outdoor equipment, there shall be an internal isolation pad in addition to the friction pad on the bottom.

G. Type "HD"

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers.

H. Type "30N"

1. Hangers shall consist of rigid steel frames containing a minimum one and one-quarter (1.25) inch thick neoprene element at the top and a steel spring as described in Subsection 2.1.E "Type 'SLF'" and seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene molded bushings projecting through the steel box. To maintain stability, the boxes shall not be articulated as clevis hangers, nor shall the neoprene element be stacked on top of the spring. Spring and hanger lower hole diameters shall be large enough to permit the hanger rod to swing through a thirty (30) degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the thirty (30) degree arc capability.

I. Type "PC30N"

1. Hangers shall be as described in Subsection 2.1.H "Type '30N'" but shall be pre-compressed and locked at the rated deflection by means of a resilient seismic up stop to keep piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a hanger drawing showing the thirty (30) degree capability.

J. Type "WBI/WBD"

1. Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup as described in Subsection 2.1.E "Type 'SLF'" and with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be present for thrust at the factory and adjusted in the field to allow for a maximum of one-quarter (0.25) inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached to the centerline of thrust and symmetrical on either side of the unit.

K. Type "SLR-MT"

1. Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable and flexible nylon (Kevlar) reinforced

neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of three (3) hertz. Air springs shall be designed for a burst pressure that is a minimum of three (3) times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed height and operating height shall be equal. A minimum clearance of one-half (0.5) inch shall be maintained around restraining bolts and between the housing and air springs to avoid interference with any air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three (3) leveling valves to maintain level within plus or minus one-eighth (0.125) inch. Air spring mounts shall be located between the supporting steel and the roof, or the grillage and dunnage as shown on the Drawings when there is no provision for direct mounting. Submittals shall include natural frequency and tests for load and damping performed by an independent lab or acoustician.

2.2 BASES

A. Type "WF"

1. Welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. Vibration manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be "T" or "L" shaped. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to one-tenth (1/10) of the longest dimension of the base. Base depth need not exceed fourteen (14) inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

B. Type "ICS"

1. Vibration isolation manufacturer shall provide steel members welded to height savings brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent distortion and misalignment of equipment.

C. Type "RBMK"

1. Vibration isolation manufacturer shall furnish structural steel concrete pouring forms for floating concrete bases. Wood formed bases, steel formed bases, and sheet metal formed bases shall not be acceptable. Pump bases for split-case pumps shall be large enough to support suction and discharge elbows. Bases may be "T" or "L" shaped where space is a problem. Bases shall be a minimum of one-twelfth (1/12) of the longest dimension of the base but not less than six (6) inches. Base depth need not exceed twelve (12) inches unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include concrete reinforcement consisting of bars that are a minimum of one-half (0.5) inch and welded in place on six (6) inch centers, running both ways in a layer of one and

one-half (1.5) inch above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Recessed height saving brackets shall be employed in all mounting locations to maintain a one (1) inch operating clearance under the base.

2.3 FLEXIBLE PIPE CONNECTIONS

- A. Type "SFDEJ," "SFEJ," "SFDJR," "SFU," and "CR" (control rods):
1. Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions shall have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out.
 2. Flexible cable wire shall not be acceptable.
 3. Sizes one and one-half (1.5) inch through fourteen (14) inches shall have a ductile iron external ring between the two spheres.
 4. Sizes sixteen (16) inches through twenty-four (24) inches may be a single sphere.
 5. Sizes three-quarters (0.75) inch through two (2) inches may be a single sphere, bolted threaded flange assemblies and cable retention.
 6. Minimum ratings through fourteen (14) inches shall be two hundred and fifty (250) PSI at one hundred and seventy (170) degrees Fahrenheit and two hundred and fifteen (215) PSI at two hundred and fifty (250) degrees Fahrenheit.
 7. Minimum ratings for sixteen (16) inches through twenty-four (24) inches shall be one hundred and eighty (180) PSI at one hundred and seventy (170) degrees Fahrenheit and one hundred and fifty (150) PSI at two hundred and fifty (250) degrees Fahrenheit.
 8. Higher published rated connectors may be used where required.
 9. Safety factors shall be a minimum of three hundred (300) percent. All expansion joints shall be factory tested to one hundred and fifty (150) percent of maximum pressure for twelve (12) minutes before shipment.
 10. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through one-half (0.5) inch thick neoprene washer bushings large enough to take the thrust at one thousand (1000) PSI of surface area may be used on unanchored piping where the manufacturer determines the conditions exceed the expansion joint rating without them.
 11. Submittals shall include two (2) test reports by independent consultants showing minimum reductions of twenty (20) decibels in vibration accelerations and ten (10) decibels in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.
 12. All expansion joints shall be installed on the equipment side of the shut-off valves.

2.4 MECHANICAL ANCHOR BOLTS

- A. Drilled-in and stud-wedge type or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength

characteristics required for anchoring and as tested according to the ASTM E488 "Standard Test Methods for Strength of Anchors in Concrete Elements" requirements. The stud anchors shall have an evaluation report number from the ICC-ES verifying its allowable loads.

2.5 ADHESIVE ANCHOR BOLTS

- A. Drilled-in and capsule anchor system containing polyvinyl chloride or urethane methacrylate-based resin and accelerator; or an injected polymer; or a hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength characteristics required for anchoring and as tested according to the ASTM E488 "Standard Test Methods for Strength of Anchors in Concrete Elements" and ICC-ES AC308 "Post-installed Adhesive Anchors in Concrete Elements" requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the work required.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations prior to installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING ISOLATION

- A. Horizontal piping:
 - 1. Isolate all pumped water, pumped condensate, and refrigerant piping sizes one and one-quarter (1.25) inch and larger within mechanical rooms and pipe sizes two (2) inches and larger outside mechanical rooms shall also be isolated. Outside equipment rooms, this piping shall be isolated for the greater of fifty (50) feet or one hundred (100) pipe diameters from externally isolated equipment. For the first three (3) support locations from the externally isolated equipment, provide Type "30N" hangers or Type "SLF" floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a one (1) inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping yet also permitting piping to function as a floating system. Size hangers for two hundred (200) percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Riser piping:
 - 1. Isolate all vertical pipe risers one and one-quarter (1.25) inch and larger, where specifically shown and detailed on riser diagrams, shall be fully supported by Type "SLF" mounts with precompression plates and brackets. Refer to manufacturer's details for additional information. Steel spring deflection shall be three-quarters (0.75) inch minimum. In locations where added deflection is required due to pipe

expansion and contraction, the spring deflection shall be a minimum of four (4) times the anticipated movement to prevent binding. Provide Type "SWS" wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations shall show anticipated expansion and contraction at each support point, initial and final loads on the build structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none exist in the proposed design.

3.3 INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points as well as with requirements for concrete reinforcement and formwork as specified in Division 03.
- B. Installation of vibration isolators shall not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Locate isolation hangers as near to the overhead support structure as possible.
- D. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below the base is provided when supported equipment has been installed and loaded for operation.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and ensure that units are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices, if any, intended for temporary protection against overloading during installation or shipment.
- H. Install cables so they do not bend across edges of adjacent equipment or building structure.
- I. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- J. Install bushing assemblies for anchor bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to walls.
- K. If specific attachment to structure is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- L. Drilled-in anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical conduit, telecommunications conduit, and gas lines.

2. Drilling holes in concrete or masonry prior to concrete, mortar, or grout achieving full design strength shall not be acceptable.
3. At wedge anchors, protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with the sleeve fully engaged in the structural element to which the anchor is to be fastened.
4. At adhesive anchors, clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes beginning at the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections. Coordinate with the Owner, through the Architect, for additional requirements prior to engaging the test.
- B. Perform tests and inspections as required and as indicated below:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to the authorities having jurisdiction.
 2. Schedule test with the Owner, through the Architect, prior to connecting anchorage devices to restrained components (unless post-connection testing has been approved) and with at least seven (7) days of advance notice.
 3. Obtain the Architect's approval prior to transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test a minimum of four (4) installed anchors and fasteners of each type and size as selected by the Architect. Provide additional testing of more anchors if instructed by the Owner or Architect.
 5. Test to ninety (90) percent of the rated proof load of device.
 6. Measure isolator restraint clearance and isolator deflection.
 7. Verify snubber minimum clearances.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops to they are out of contact during normal operation.

END OF SECTION 22 05 48.13

SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. It is the intent of this Section to provide requirements for commissioning of plumbing systems, subsystems, and equipment. This Section supplements the general requirements specified in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS.
- B. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.
- C. The requirements of this Section shall apply to all Sections of Division 22.
- D. This project shall have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor shall be responsible for executing, is defined in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) shall be appointed by the Owner or the Owner's representative.
- E. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS for definitions and additional information.

1.3 REFERENCES

- A. Division 01 Specification Sections
- B. 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS
- C. 01 33 00 – SUBMITTAL PROCEDURES

1.4 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel in accordance with the requirements of Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS and of Division 22, is required in cooperation with the Owner and the CxA.
- B. The plumbing systems commissioning will include the systems listed in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS.

1.5 SUBMITTALS

- A. The commissioning process requires review of selected submittals. The CxA shall provide a list of submittals that shall be reviewed by the CxA. This list shall be reviewed and approved by the Owner prior to forwarding to the Contractor. Refer to Section 01 33 00 – SUBMITTAL PROCEDURES for further details.

- B. The commissioning process requires review of submittals simultaneously with engineering review. Specific submittal requirements related to the commissioning process are as specified in Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS.

PART 2 – PRODUCTS (N/A)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of the building plumbing systems shall require inspection of individual elements of the plumbing construction throughout the construction period. The Contractor shall coordinate with the CxA in accordance with Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS and the commissioning plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete pre-functional checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for systems functional performance testing. The CxA will prepare pre-functional checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Owner and to the CxA for review. The CxA may spot check a sample of completed checklists. If the CxA determines that the information provided on the checklists is not accurate, the CxA will return the checklist with markups to the Contractor for correction and resubmission. If the CxA determines that a significant number of completed checklists for similar equipment are not accurate, the CxA will select a broader sample of checklists for review. If the CxA determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for pre-functional checklists, equipment startup reports, and other commissioning documents.

3.3 CONTRACTOR TESTS

- A. Contractor tests, as required by other Sections of Division 22, shall be scheduled and documented in accordance with Division 01. All testing shall be incorporated into the project schedule. The Contractor shall provide no less than seven (7) days of advance notice of testing. The CxA will witness selected Contractor tests at the sole discretion of the CxA. Contractor tests shall be completed prior to scheduling systems functional performance testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The commissioning process includes systems functional performance testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and to test system performance under emergency conditions. The CxA will prepare detailed systems functional performance test procedures for review and approval by the Engineer. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The CxA will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS for additional information.

3.5 TRAINING OF OWNER PERSONNEL

- A. Training of the Owner's operation and maintenance personnel shall be required in cooperation with the Engineer and CxA. Provide competent, factory-authorized personnel to provide instruction to the operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS. The instruction shall be scheduled in coordination with the Engineer after submission and approval of formal training plans. Refer to Section 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS and Sections of Division 22 for additional Contractor training requirements.

END OF SECTION 22 08 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. Provide a complete domestic water piping system.
- B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.
- C. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
 - 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.7 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 WATER PIPING, BELOW GRADE

- A. Copper Tubing: ASTM B88, Type K.
 - 1. Fittings: ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP silver braze.

2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing 6" and smaller: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints:
 - a. Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
 - b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - c. Appurtenances for Grooved-End Copper Tubing:
 - 1) Manufacturers: Subject to compliance with requirements, provide products from the following or approved equal:
 - a) Victaulic
 - 2) Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - 3) Mechanical Couplings for Grooved-End Copper Tubing:
 - a) Copper-tube dimensions and design similar to AWWA C606.
 - b) Ferrous housing sections.
 - c) EPDM-rubber gaskets suitable for hot and cold water.
 - d) Bolts and nuts.
 - e) Minimum Pressure Rating: 300 psig.
 - 3. At the contractor's option, Press connection copper fittings manufactured by an approved manufacturer or approved equal will be acceptable. Building services piping -20 degrees to +250 degrees up to 200 PSI. Fittings shall comply with NSF-61, CSA, UPC. Seals shall be made of EPDM material and manufactured with an inboard bead design. The fittings shall include the Smart Connect feature to identify unpressed connections during system testing. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.
 - a. The only approved manufacturer:

1) Viega

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size two (2) inches and Smaller:
 - 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 - 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Pipe Size 2-1/2 inches and Larger:
 - 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
 - 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
 - 3. PEX-a tube and pipe: Class 150 ASME B16.5 flanges; ASTM F1960 joints.

2.5 GALVANIC PROTECTION

- A. Dissimilar piping material connections shall not be made without an approved dielectric union.
- B. Dielectric Connections:
 - 1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Provide Watts Series LF3001A or an approved equal.
 - 2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick preformed neoprene gasket.

2.6 VALVES

- A. General
 - 1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
 - 2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.
- B. Ball Valves:
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Bray.
 - 2. Two (2) inches and Smaller: Nibco S/T-585-80-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, two piece body, chrome plated silicon bronze ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
 - 3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.

Memory stops, which are fully adjustable after insulation is applied, shall be included.

4. Ball valves installed outdoors or in-ground shall have stainless steel handle.
5. Ball Valves for PEX-a Two (2) inches and smaller: NSF 359, Class 150, 250 psi CWP, forged brass, two piece body, brass ball, Teflon (PTFE) seats, blow-out proof stem, lever handle, ASTM F1960 ends. No Lead. Basis of design Uponor Lead-free Commercial Ball Valves.
6. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
7. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

C. Shut-off Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
2. Line Shut-Off Valves 2-1/2" to 3" where system operating pressure will not exceed 300 p.s.i.g. shall be 300 WOG LEAD-FREE ductile iron body with non-rising stem, ductile iron wheel handle, bronze stem and flange ends. Acceptable valves are Nibco F-619-RWS, or approved equivalent model by Kitz, Bray, Milwaukee, or Apollo.
3. Line Shut-Off Valves 4" and larger where system operating pressure will not exceed 300 p.s.i.g. shall be 300 CWP ductile iron body gate valve with non rising stem, resilient wedge, flange ends, EPDM liner and seal. Acceptable valves are NIBCO Model F-619-RWS/SON, or approved equal.
4. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.

D. Swing Check Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
3. 2-1/2 inches and Larger: NIBCO INC. F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.

E. Balancing Valves (Hot Water Recirculation)

1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi maximum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
2. Balancing valves shall be IMI Flow Design model UA Zero series (0.5 to 1.5 GPM venturi range) or approved equal by ITT or Bell and Gossett. Provide extended handle as required.
3. Ball valves are not acceptable for balancing the hot water return system.
4. Provide a ball valve (for isolation purposes) and a strainer immediately upstream of the balancing valve, and then provide a check valve and ball valve (for isolation purposes) immediately downstream of the balancing valve. Valves and appurtenances shall be sized in accordance with the hot water return line size.

2.7 STRAINERS

- A. Manufacturer: Watts, Crane or approved equal.
- B. Two (2) inches and Smaller: Threaded (lead free) cast copper silicon alloy for 400 PSI WOG, wye pattern with 1/32 inch stainless steel perforated screen. Watts Series LF777.
- C. 2-1/2 and Larger: Class 125, flanged (lead free) cast iron strainer for 200 PSI WOG, wye pattern with 1/16-inch stainless steel perforated screen. Watts Series 77F-DI-125.
- D. Lead Free.

2.8 GAGES AND TAPS

- A. Manufacturers: For portable water system (Lead Free)
 - 1. Weiss
 - 2. Marsh Bellofram
 - 3. Weksler
 - 4. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Phosphor bronze.
 - 3. Dial Size: 4-1/2 diameter.
 - 4. Mid-Scale Accuracy: One (1) percent.
 - 5. Scale: Psi.
- C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.
- D. Ball Valve: Brass 1/4 inch NPT for 250 psi.
- E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.

- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe on prepared bedding.
- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Do not use lead bearing solder materials.
- I. Pipe Cover and Backfilling:
 - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 3. Do not use wheeled or tracked vehicles for tamping.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.
- B. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Insulate all domestic hot water supply and return lines.
- D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

- L. Install water piping in accordance with ASME B31.9.
- M. Sleeve pipes passing through partitions, walls and floors.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.
- R. Provide check valves on discharge of all water circulating pumps.
- S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.
- V. Route all domestic water piping inside building in climate controlled space not subject to freezing.
- W. Do not use lead bearing solder materials.
- X. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 23 07 16 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- Y. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas. Size plates to fit pipe or insulation and lock in place.
- Z. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.
- AA. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
- BB. Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for ASTM F 1960 connections.
- CC. Lead Free.

3.5 INSTALLATION - SERVICE CONNECTIONS

- A. At each incoming water service line provide approved reduced pressure back-flow preventer. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.
- C. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.

3.6 INSTALLATION - BACKFLOW PREVENTERS

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.
- B. Provide at water supply to fire protection system.
- C. Provide a floor drain within six (6) feet of each backflow preventer.
- D. Backflow preventer shall be certified by Contractor.
- E. Lead Free.

3.7 INSTALLATION – PRESSURE GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install gage in piping to each inlet and outlet of water heater.
- E. Install gage in piping to each end of backflow preventer.
- F. Install gage in piping to each end of double check valves.
- G. Install gage in piping to each inlet and outlet of water softener.
- H. Install gage in piping to each inlet of water filter.
- I. Install gage in piping to each inlet of commercial dishwasher machine.

3.8 DOMESTIC HOT WATER SYSTEM BALANCING

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.
- D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in "Permits" under Part 1 of Section 22 05 00.

3.9 FIELD QUALITY CONTROL

- A. Pressure test all domestic water piping.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.
- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.
- E. Installers for PEX-a piping shall have completed the applicable training courses per manufacturer's requirements.
- F. Cleaning of piping systems:
 - 1. General cleaning of piping systems: Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.
 - 2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only.
 - 3. Phase One: Initial flushing of system.
 - a. Remove loose dirt, mill scale, weld beads, rust and other deleterious substance without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
 - b. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
 - 4. Phase Two: Cleaning of Piping Systems:

- a. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing.
 - b. Flush system and replace with clean water.
 - 5. Phase Three: Final flushing and rinsing:
 - a. Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 - 6. Submit status reports upon completion of each phase of work on each system.
- G. Branch Connections:
 - 1. Pipe 2" and smaller. For threaded piping, use straight size reducing tee. When branch is small than header, a nipple and reducing coupling or swagged nipple may be used.
- H. 2-1/2" through 36". For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.
- I. See section 220500 for additional requirements.

END OF SECTION 22 11 16

SECTION #22 13 13 – FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes gravity-flow, outside the building, with the following components:
 - 1. Cleanouts
 - 2. Manholes
- B. All public work to be performed and materials to be used within the street right-of-way, shall be in accordance with the City of Austin Design Standards.
- C. All private work to be performed and materials to be used beyond the street right-of-way shall be in accordance with the Plumbing Code. In the event of a discrepancy between the above-referenced standards, the plans, and/or any portion of this specification section, the order of precedence will be the plans, the City Design Standards, and then these specifications. The Contractor shall contact the engineer in the event of a discrepancy.

1.2 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa).

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Special pipe fittings.
- B. Shop Drawings: For the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Field Quality-control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Pressure Pipe: AWWA C900, Class 150, for gasketed joints and using ASTM F 477, elastomeric seals.
 - 1. Fittings NPS 4 to NPS 8 (DN 100 to DN 200): PVC pressure fittings complying with AWWA C907, for gasketed joints and using ASTM F 477, elastomeric seals.

2. Fittings NPS 10 (DN 250) and Larger: Ductile-iron, compact fittings complying with AWWA C153, for push-on joints and using AWWA C111, rubber gaskets.
- B. PVC Sewer Pipe and Fittings, NPS 16 and Smaller: ASTM D 3034, SDR 26, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.2 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
 2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.3 MANHOLES

- A. Precast Concrete Manholes: ASTM C 478, precast, reinforces concrete, of depth indicated, with provision for rubber gasketed joints, and pipe boots.
 1. Inside diameter: 48 inches minimum, unless otherwise indicated.
 2. Base section: 8 inches minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section and having separate base slab or base section with integral floor.
 3. Riser sections: 5-inch minimum thickness.
 4. Top Section: Eccentric-cone type, unless otherwise indicated.
 5. Gaskets: ASTM C 443, rubber (when required by local authority having jurisdiction).
 6. Pipe connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 7. Joints of the manhole sections shall be of the tongue and groove type, filled with an approved preformed butyl rubber base, sealing compound, conforming to Federal Specifications SS-S210A, Type 1, Rope form.
 8. Inside of the manhole shall have a Thane Coat installed for all sanitary manholes located inside of the property boundary.
- B. Standard manhole frames and covers shall conform to the standard detail of the regulatory authorities having jurisdiction for the project (if applicable). Otherwise, manhole frames and covers to be Neenah Foundry Co. No. R-1642 or Vulcan Foundry Inc. No. V-1357, 30" opening.
- C. All sanitary sewer manhole covers shall have the word "SANITARY SEWER" cast on the top in letters 2 inches higher.

2.4 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug, with a 2' x 2' x 6" thick concrete apron.
 1. Available Manufacturers:
 - a. Refer to City of Austin Utility Standards, latest edition.
 2. Top-Loading Classification: Extra-heavy duty.
 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.5 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. Unshielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
 - 2. Use pressure-type pipe couplings for force-main joints.
- B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- C. Gravity-Flow, Nonpressure Sewer Piping:
 - 1. NPS 3 (DN 80): NPS 4 (DN 100) PVC sewer pipe and fittings, gaskets, and gasketed joints.
 - 2. NPS 4 (DN 100): PVC sewer pipe and fittings, gaskets, and gasketed joints.
 - 3. NPS 5 and NPS 6 (DN 125 and DN 150): NPS 6 (DN 150) PVC sewer pipe and fittings, gaskets, and gasketed joints.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 - 2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install piping with 36-inch (915-mm) minimum cover.
 - 4. Install piping below frost line.
 - 5. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
 - 6. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

3.4 PIPE JOINT CONSTRUCTION

- A. Basic piping joint construction is specified in Division 22 Section "Common Work Results for Plumbing" Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 - 2. Join dissimilar pipe materials with nonpressure-type, flexible [or rigid] couplings.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 923.
- C. Construct cast-in-place manholes as indicated.
- D. Install PE sheeting on earth where cast-in-place-concrete manholes are to be built.
- E. Install FRP manholes according to manufacturer's written instructions.
- F. Form continuous concrete channels and benches between inlets and outlet.
- G. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches (76 mm)] above finished surface elsewhere, unless otherwise indicated.
- H. Install manhole cover inserts in frame and immediately below cover.

3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.7 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 - 2. Use extra-heavy-duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 24" by 24" by 6" deep. Set with tops 1 inch (25 mm) above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.8 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22 Section "Sanitary Waste and Vent Piping."

- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches (150 mm) of concrete for minimum length of 12 inches (300 mm) to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain minimum 28-day compressive strength of 3000 psi (20.7 MPa), unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to grease interceptors specified in Division 22 Section "Sanitary Waste Interceptors."

3.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.
 - 1. Submit separate report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter. Hand pulled no earlier than 30 days after backfill was completed.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.
 5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
 - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile (4.6 L/millimeter of nominal pipe size per kilometer) of pipe, during 24-hour period.
 - b. Close openings in system and fill with water.
 - c. Purge air and refill with water.
 - d. Disconnect water supply.
 - e. Test and inspect joints for leaks.
 - f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig (69 kPa).
 6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
 - b. Option: Test concrete gravity sewer piping according to ASTM C 924 (ASTM C 924M).
 7. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- 3.10 CLEANING**
- A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

END OF SECTION #22 13 13

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. Provide a complete sanitary drainage system.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and clean-outs.
- B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SANITARY SEWER PIPING, BELOW GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
- B. PVC Pipe
 - 1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
 - 2. Solvent welded joints shall conform to IAPMP installation standards IS-9.
 - 3. Pipe and fittings shall conform to ASTM D 1784, AST D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.
- C. CPVC Pipe (Grease Waste Applications)
 - 1. Provide a complete system of solid wall schedule 40 CPVC DWV piping with solvent welded joints.
 - 2. Solvent welded joints shall conform to IAPMO installation standards.
 - 3. Provide tracer wire at all under slab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
 - 4. Pipe and fittings basis of design shall be Charlotte ChemDrain® Chlorinated Polyvinyl Chloride (CPVC-cwd) schedule 40, non-pressure DWV type conforming to ASTM F2618.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel

shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.

- a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.
3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

2.4 VENT PIPING, ABOVE GRADE

- A. Manufacturers
 1. AB&I
 2. Charlotte Pipe and Foundry Co.
 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon, Tyler Wide Body or Husky HD-2000.

2.5 VENT PIPING, BELOW GRADE

- A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

- A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.
- B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- C. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert as indicated on Drawings.

- B. Establish minimum separation from other services piping in accordance with code.
- C. Remove scale and dirt on inside of piping before assembly.
- D. Install with a uniform slope of not less than 1/4 of an inch per foot.
- E. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- F. Route pipe in straight line.
- G. Excavation:
 - 1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
 - 2. Cut the bottom of the trench or excavation to uniform grade.
 - 3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.
- H. Pipe Cover and Backfilling:
 - 1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
 - 2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
 - 3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at www.uni-bell.org.
 - 4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- I. Disposal of excess material:
 - 1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one (1) percent) minimum or as required per the code if more stringent. All grease waste piping upstream

of a grease interceptor shall be sloped to 1/4 inch per foot (two (2) percent) per code. Maintain gradients.

- B. Provide and installed cleanout as required by code and local AHJ.
- C. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- D. Install a floor clean out according to the following;
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. At each change of direction greater than 45 Deg.
 - 3. At the base of each waste or soil stack.
 - 4. Install floor cleanouts at elevation to accommodate finished floor.
 - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 - 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waste lines.
 - 7. Do not locate floor cleanouts in public areas unless approved by the Owner as per Huffman ISD Construction and Design Standards.
- E. Install a wall cleanout according to the following:
 - 1. Provide cleanouts in bathrooms per Huffman ISD Construction and Design Standards.
 - 2. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals per code. Wall cleanout shall be flush with accessible side of wall.
 - 3. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets where pipes penetrate the slab including water closets, lavatories and drinking fountains.
 - 4. **Cleanouts in the wall shall be above the rim of the lowest fixture(s) being served to prevent the waste of the associated fixture(s) from discharging on the floor when maintenance needs to inspect and snake the line.**
- F. Install an exterior cleanout according to the following:
 - 1. Encase exterior cleanouts in concrete flush with grade.
 - 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect per code (within 5'-0" of building exterior wall as per Huffman ISD Construction and Design Standards).
- G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- I. Install piping to maintain headroom. Do not spread piping, conserve space.
- J. Group piping whenever practical at common elevations.
- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- N. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.
- Q. Install bell and spigot pipe with bell end upstream.
- R. Sleeve pipes passing through partitions, walls and floors.
- S. Support cast iron drainage piping at every joint.
- T. Water test all piping per code.
- U. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- V. Slope all vent piping to allow for drainage.
- W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.
- X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.
- Y. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

3.5 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

3.6 FIELD QUALITY CONTROL

- A. Separate trenches for water lines, sanitary, storm, and gas piping.

- B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.
- C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.
- D. Foreign pipe and fittings unacceptable.
- E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.
- F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.
- G. For additions and renovations, use camera to locate routing of underslab lines.
- H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

END OF SECTION 22 13 16

SECTION 22 14 13 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete storm drainage piping system.
- B. Section Includes:
 - 1. Storm Piping Below Grade
 - 2. Storm (Including Overflow) Piping Above Grade

1.3 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 STORM WATER PIPING, BELOW GRADE

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: ASTM C564 and ASTM C1563, neoprene gasket system or lead and oakum.
- B. PVC Pipe
 - 1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
 - 2. Provide tracer wire at all underslab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
- C. Contractor Option: Provide a complete system of schedule 40 PVC with solvent welded joints.
- D. Foam core PVC piping is not acceptable for any drainage system.

2.3 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon or Husky HD-4000.
 - 3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe with uniform slope of not less than 1/8 of an inch per foot.
- F. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- G. Route pipe in straight line.
- H. Pipe Cover and Backfilling:
 - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of pipe.
 - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 3. Do not use wheeled or tracked vehicles for tamping.
- I. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage 1/8 inch per foot (one (1) percent) minimum. Maintain gradients.
- B. Provide and installed cleanout as required by code and local AHJ.
- C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearance at cleanout for snaking drainage system.
- D. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.
- E. Install a floor clean out according to the following;
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. Install floor cleanouts at elevation to accommodate finished floor.
 - 3. At each change of direction greater than 45 Deg.

4. At the base of each waste or soil stack.
 5. Install floor cleanouts at elevation to accommodate finished floor.
 6. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 7. Do not locate floor cleanouts in public areas unless approved by the Owner as per Huffman ISD Construction and Design Standards.
- F. Install a wall cleanout according to the following:
1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall.
 2. Provide wall cleanouts at all bathroom chase waste piping.
- G. Install a exterior cleanout according to the following:
1. Encase exterior cleanouts in concrete flush with grade.
 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect per code (within 5'-0" of building exterior wall as per Huffman ISD Construction and Design Standards).
- H. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines
- I. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- J. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- K. Install piping to maintain headroom. Group piping to conserve space.
- L. Group piping whenever practical at common elevations.
- M. Support cast iron drainage piping at every joint.
- N. Provide bracing at horizontal pipe and fittings larger than 4 inches in size. Pipe and fittings shall be suitably braced to prevent horizontal movement at every branch opening or change of direction by use of braces, blocks, rodding, or other suitable method as required to prevent movement or joint separation.
- O. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- P. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- Q. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- R. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- S. Install bell and spigot pipe with bell end upstream.
- T. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.

- U. Provide heavy-duty clamps, fittings and gaskets at no-hub connections to all roof and overflow drains then transition to bell and spigot piping system.
- V. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.
- W. Insulate all horizontal storm and overflow drain piping with fiberglass insulation with service jacket. For exposed locations provide rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow all the way to change to vertical direction, including y-fittings.

3.4 RODDING SEWERS

- A. All storm lines, both in the building and out, shall be rodded out after completion of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

END OF SECTION 22 14 13

SECTION 22 15 13 - COMPRESSED-AIR PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. This Section includes piping and related specialties for general-service compressed-air systems operating at 125 psig and less. Make connections to compressor, dryer, filter, and other related items of equipment and piping accessories, and extend air piping through building to all equipment, fixtures and outlets requiring same.

1.4 SUBMITTALS

- A. Product Data for the following:
 - 1. Pipes, tubes, and fittings.
 - 2. Flexible pipe connectors.
 - 3. Safety valves.
 - 4. Pressure regulators.
 - 5. Filters
 - 6. Automatic drain valves.
 - 7. Quick couplings.
 - 8. Hose assemblies.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SYSTEM DESCRIPTION

- A. Shop air operating at 125 psig (1200 kPa).

2.3 PIPES, TUBES AND FITTINGS

- A. Schedule 40, Galvanized steel Pipe: ASTM A 53.
 - 1. Steel Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded. Provide Class 300 and galvanized finish if indicated.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150, threaded.
 - 4. Wrought-Steel Fittings: ASME B16.9, Schedule 40, butt welding.
 - 5. Forged-Steel Fittings: ASME B16.11, socket type.
 - 6. Steel Flanges: ASME B16.5, Class 150, carbon steel.
 - 7. Press-Connect Fittings: MegaPressG ANSI LC-4/CSA 6.32.
- B. Flexible Pipe Connectors: Corrugated tubing with wire-braid covering.
 - 1. Manufacturers:
 - a. ANAMET Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Hyspan Precision Products, Inc.
 - e. Mercer Rubber Co.
 - f. Metraflex, Inc.
 - g. Proco Products, Inc.
 - h. Unaflex, Inc.
 - 2. Stainless-Steel-Hose/Steel Pipe Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - a. Working-Pressure Rating: 200 minimum.
 - b. End Connections NPS 2 and Smaller: threaded Steel pipe nipple.
 - c. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.4 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 VALVES

- A. Ball Valves:
 - 1. 1/4 inch to one (1) inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70.
 - 2. 1-1/4 inch to 3 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port. Nibco T-580-70.

2.6 SPECIALTIES

- A. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
 - 1. Manufacturers:
 - a. Aeroquip Corporation.
 - b. Bowes Manufacturing, Inc.
 - c. Foster Manufacturing Co., Inc.
 - d. Milton Industries, Inc.
 - e. Parker Hannifin Corporation; Fluid Connectors Group; Quick Coupling Div.
 - f. Rectus Corp.
 - g. Schrader-Bridgeport; Amflo Div.
 - h. Schrader-Bridgeport/Standard Thomson.
 - i. Snap-Tite, Inc.
 - j. TOMCO Products Inc.
 - k. Tuthill Corporation; Hansen Coupling Div.
 - 2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 - b. Plug End: Straight-through type with serrated outlet for attaching hose.
- B. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
 - 1. Hose: double-wire-braid, CR-covered hose for compressed-air service.
 - 2. Hose Clamps: Stainless-steel clamps or bands.
 - 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with serrated ends for connecting two sections of hose.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the follow conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
 - 1. Notify Owner not less than seven (7) days in advance of proposed interruption of compressed-air service.

3.2 PIPING APPLICATIONS

- A. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating use din applications below, unless otherwise indicated.
- B. Joining of Dissimilar Metal Piping: Use dielectric fittings.
 - 1. NPS 2 and Smaller: Dielectric unions.
 - 2. NPS 2-1/2 to NPS 4: Dielectric flanges.
 - 3. NPS 6 and Larger: Dielectric flange kits.
- C. Low-Pressure Compressed-Air Piping: Use the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron or press-connect fittings; and threaded or press-connected joints.
 - 2. NPS 6 to NPS 12: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.

3.3 PIPING INSTALLATION

- A. Install air and drain piping with 1 percent slope downward in direction of airflow.
- B. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- C. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- D. Install flexible pipe connector on each connection to air compressors.
- E. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver.

3.4 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

- C. Install pressure regulators on compressed-air piping where reduced pressure is required.
- D. Install flexible pipe connectors in discharge piping [and in inlet air piping from remote air-inlet filter] of each air compressor.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to specialties and equipment to allow service and maintenance.
- C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
 - 2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 3. Repair leaks and retest until no leaks exist.
 - 4. Report results in writing.

END OF SECTION 22 15 13

SECTION 22 20 23 - GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.
- B. This section covers the complete first class natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. 2015 Edition of the International Fuel Gas Code.
 - 2. Latest Edition of NFPA 54, National Fuel Gas Code.
 - 3. Minimum Safety Standards for Natural Gas, 49 Code of Federal Regulations (CFR) Part 192, as Required by Title 16 of the Texas Administration Code § 8.70.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

- 3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
 - d. Tape form pipe coating.
- B. Test Reports: Indicate results of piping system pressure test.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, piping system, and system components.
- B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. Installation of natural gas systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME Section 9.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.9 EXTRA MATERIALS

- A. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.3 NATURAL GAS PIPING, BELOW GRADE

- A. Provide Underground Gas Polyethylene (PE), SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.
 - 1. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.
 - 2. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.

2.4 NATURAL GAS PIPING, ABOVE GRADE (OUTDOOR)

- A. Piping 1½ inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.
- B. Piping 2 inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.
- C. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.
- D. **As per Huffman ISD Construction and Design Standards, all gas piping in service yards, mechanical spaces, and on rooftops shall be painted "Safety Yellow" color. Color match the pipe to the wall when it goes up to the wall onto the rooftops and extend color matching 5'-0" onto the rooftop.**

2.5 NATURAL GAS PIPING, ABOVE GRADE (INDOOR)

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M forged steel welding type.
 - 2. Joints: NFPA 54, Welded to ASME B31.9.
 - 3. NOTE:
 - a. All exposed piping 1½ inches and smaller located within areas utilized as return air plenums shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.
 - b. All exposed piping 1½ inches and smaller serving laboratories from main natural gas riser to each emergency shut-off valve shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.6 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 VALVES

- A. Manufacturers:
 - 1. NIBCO.
 - 2. Milwaukee.
 - 3. Keystone
- B. Ball Valves:
 - 1. 1/4 inch to 2-1/2 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.
 - 2. 3 to 4 inch, MSS SP 110, 250 psi, two piece, threaded ends, brass body, stainless steel ball, reinforced teflon seats, blow-out proof stem, lever handle, UL listed for flammable liquids and LPG, Full port. Nibco T-FP-600A (CSA, UL, FM).
 - 3. 3 inch and larger, MSS-SP-78, Type IV, Class 125, ASME/ANSI B16.38, 200 psi, lubricated plug valves with flanged or threaded ends. Bodies, plugs and bonnets shall be made from Gray Iron castings, ASTM A-126, Class B. Homestead Valve series 600 (CSA, UL, FM).

2.8 STRAINERS

- A. Manufacturers:
 - 1. O.C. Keckley Company or approved equal.
- B. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to four (4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Five (5) inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 NATURAL GAS PRESSURE REGULATORS

- A. Manufacturers:
 - 1. Rockwell Meter Co.
- B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
 - 1. Temperatures: minus 20 degrees Fahrenheit to 150 degrees Fahrenheit.
 - 2. Body: Steel.
 - 3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
 - 4. Disk, diaphragm, and O-ring: Nitrile.
 - 5. Maximum inlet pressure: 150 psig
 - 6. Furnish sizes two (2) inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.
- C. As per Huffman ISD Construction and Design Guidelines, mount all regulators at equipment where possible.

2.10 NATURAL GAS PRESSURE RELIEF VALVES

- A. Manufacturers:
 - 1. Rockwell Meter Co.
- B. Product Description: Spring loaded type relief valve.
 - 1. Body: Aluminum.
 - 2. Diaphragm: Nitrile.
 - 3. Orifice: Brass.
 - 4. Maximum operating temperature: 150 degrees Fahrenheit.
 - 5. Inlet Connections: Threaded.
 - 6. Outlet or Vent Connection: Same size as inlet connection.

2.11 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service.

2.12 PROTECTIVE COATING

- A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using "Scotchwrap," "CT Tapecoat" or "X-Tru-Tape." Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

2.13 EMERGENCY SHUT-OFF VALVE

- A. Kitchen.
 - 1. The main gas supply to kitchen equipment shall be provided with an automatic solenoid valve with manual reset lever. The valve shall be interconnected with the hood fire suppression system to shut down gas supply to all kitchen equipment.
 - 2. The valve shall be energized to open, closed when de-energized with manual reset. The required voltage shall be coordinated with the electrical contractor. The valve shall carry a UL Listing.
 - 3. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
 - 4. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
 - 5. Valves 3/4"-2-1/2" in size shall be ASCO 8044 series.

PART 3 - EXECUTION

3.2 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipe line.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Establish minimum separation of gas pipe from other services, piping in accordance with code.
- C. Install continuous jacket or tape.
- D. Install gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- E. Install Work in accordance with Gas Company standards.

- F. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- G. Provide pipe sleeve as required for gas pipe routing under slab or in conceal space.
- H. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.
- E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.
- F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- G. Install service pipe and set gas meters in accordance with Gas Company regulations. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- H. Gas piping installed in plenums and chases shall be welded.
- I. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.
- J. Provide a manual shut off valve on the appliance gas supply line in addition to the Kitchen Ansul unit automatic shut off.
- K. Provide a gas valve manifold to isolate kitchen gas appliances individually at one location.
- L. Provide separate gas valves on each fixture in labs.
- M. Provide a gas isolation valve on the lab controller unit.
- N. Install a test port of each side of all natural gas pressure regulators.
- O. Perform a pressure test of all replaced natural gas piping.
- P. Gas piping on roof shall be supported at appropriate intervals to prevent sagging. Spacing shall be determined by the roof type and loading. No piping shall rest directly on the roof.
- Q. All supports shall be manufactured for the purpose of supporting pipe. Wood blocks are not an acceptable means of pipe support.

3.6 FIELD QUALITY CONTROL

- A. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- B. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF SECTION 22 20 23

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete installation for each equipment type listed in this section.
- B. Section Includes:
 - 1. COMMERCIAL NATURAL GAS DOMESTIC WATER HEATER
 - 2. COMMERCIAL ELECTRIC WATER HEATERS
 - 3. VACUUM RELIEF VALVES
 - 4. IN-LINE CIRCULATORS
 - 5. T & P RELIEF VALVES
 - 6. DIAPHRAGM-TYPE EXPANSION TANKS
 - 7. GARBAGE DISPOSAL
 - 8. GREASE TRAP (Hydro)
 - 9. WATER SOFTENERS (WS-1)
 - 10. SINK PLASTER TRAP
 - 11. SAND/OIL SEPARATOR
 - 12. SOLIDS INTERCEPTOR
 - 13. AIR COMPRESSOR
 - 14. OVERHEAD AIR HOSE REEL (HR-X)
 - 15. SAMPLING WELL
 - 16. DRY WELL
 - 17. BACKFLOW PREVENTERS
 - 18. WATER PRESSURE REGULATING VALVES
 - 19. WATER HAMMER ARRESTORS
 - 20. THERMOSTATIC MIXING VALVES
 - 21. SOLENOID VALVES
 - 22. FLOW METER
 - 23. TEMPERATURE INSTRUMENTS

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and

connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.

- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 EXTRA MATERIALS

- A. Furnish two pump seals.

PART 2 - PRODUCTS

2.3 COMMERCIAL NATURAL GAS DOMESTIC WATER HEATER (Min 95% EFF)

- A. Manufacturers:
 - 1. AO Smith,
 - 2. Raypak,
 - 3. PVI,
- B. Furnish and install condensing, low NOx, modulating natural gas-fired domestic water heaters with a minimum thermal efficiency of 95% when tested to ANSI Z21.10.3 with the standby loss, and all other requirements of latest edition of ASHRAE 90.1b. The unit shall be NSF 61 standard tested and compliant for drinking water use. The dimensions, capacities, natural gas requirements and electrical characteristics of the water heater shall be as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements scheduled on Contract Drawings, indicated herein and fit properly in the space provided.
- C. Gas water heater(s) shall be equipped with a powered gas burner with electronic flame safeguard, intermittent electronic ignition, main and pilot automatic gas valves, redundant solenoid gas valve, gas pressure regulator, diaphragm switch for proof of boiler operation, and flame inspection port. Maximum gas supply pressure to heater(s) shall be 13" W.C., and ASME working pressure shall be 160 psi. Water heater(s) shall have the followings:
 - 1. Modulating gas burner that automatically adjusts the input based on demand.
 - 2. Powered anodes that are non-sacrificial and maintenance free.
 - 3. Have seamless glass-lined steel tank construction, with glass lining applied to all water-side surfaces after the tank has been assembled and welded.
 - 4. Have a down-fired power burner designed for precise mixing of air and gas for optimum efficiency, requiring no special calibration on start-up
 - 5. Be approved for 0" clearance to combustibles.

- D. The control shall be an integrated solid-state temperature and ignition control device with integral diagnostics, graphic user interface, fault history display, and shall have digital temperature readout and other components shall include manual-reset high-temperature limit control, upper and lower thermostats, combination temperature and pressure gauge, low-water cutoff, ASME-rated temperature and pressure relief valve, drain valve and draft regulator. Control compartment door shall be hinged for easy access.
1. All models are design certified by Underwriters Laboratories (UL), Inc., according to ANSI Z21.10.3 standards governing storage type water heaters.
 2. Meet the thermal efficiency and standby loss requirements of the U. S. Department of Energy and current edition ASHRAE/IES 90.1. Complies with SCAQMD Rule 1146.2 and other air quality management districts with similar requirements for low NOx emissions.
- E. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 3, 5, or 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- F. The tank shall be glass lined with alkaline borosilicate composition and fused to the steel by firing at 1600°F and shall be insulated with fiberglass insulation. The heater will also be equipped with multiple anodes for cathodic protection. Heater(s) shall be equipped with 1-1/2" NPT water inlet and outlet openings, and two 3" handhole cleanouts. The heater(s) shall be constructed on accordance with ASME code, and the entire unit listed by Underwriters Laboratories.
- G. Water heater(s) shall capable for remote monitoring, leak detection and fault alert. Provide dry contacts for shut down command from CO monitor.
- H. Capacities: GHW-X (X = as scheduled); Water storage as scheduled; Located in hot water boiler room, gallon per hour recovery at 100-degree rise.
1. Accessories:
 - a. Provide regulator for 5 lb. gas service pressure.
 - b. Provide single point power connection as scheduled.
 - c. Provide neutralization drain kit as required.
 - d. Provide Concentric vent kit as required.
 - e. Provide integral heat traps.
 - f. Provide drain pan.
 2. 120K-250K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for power venting using a 4" diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a 4"-diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping and (120 ft.) equivalent feet of intake air piping.
 3. 300K - 500K BTU Input: For Standard Power Venting: Water heater(s) shall be suitable for standard power venting using a (6") diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping. For Power Direct Venting: Water heater(s) shall be suitable for power direct venting using a (6") diameter pipe for a total distance of (120 ft.) equivalent feet of vent piping and (120 ft.) equivalent feet of intake air piping.

2.5 COMMERCIAL ELECTRIC WATER HEATERS (EWH-x)

- A. Manufacturers:
1. A.O. Smith.
 2. Bradford White.

3. State.
 4. All electric point-of-use storage tank type water heaters provided within this project shall be the product of one manufacturer.
- B. Furnish and install a Factory-assembled and wired, electric, vertical storage domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.
- C. Water heater(s) shall have the UL seal of certification and be factory equipped with an ASME rated temperature and pressure relief valve. Water heater(s) shall be constructed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section IV Part HLW. Tank(s) shall have a coating of high temperature porcelain enamel and furnished with two (2) magnesium anode rods rigidly supported. Water heater(s) shall meet or exceed the standby loss requirements of ASHRAE. Tank(s) shall have a working pressure of 160 psi and shall be completely assembled.
- D. Tank: Shall be insulated with 2-1/2" of rigid polyurethane foam insulation or with minimum two (2) inches glass fiber polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.
- E. Controls: Equip with diagnostic panel utilizing light emitting diodes. Each LED will correspond to the number and location of the heating elements and monitor their on-off function. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees Fahrenheit, flanged or screw-in nichrome elements, high temperature limit thermostat. Water heater(s) shall be provided with internal power circuit fusing, control circuit fusing, magnetic contactors, 120-volt control circuit transformer and immersion thermostat(s) with manual reset high limit control.
- F. Water heater(s) shall capable for remote monitoring, Controls, leak detection and fault alert.
- G. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 3, 5, or 10-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- H. Capacity:
1. Storage capacity: as indicated.
 2. Heating element size: as indicated.
 3. Number of heating elements: as indicated.
 4. Minimum recovery rate: (as indicated) gph with 100 degrees Fahrenheit temperature rise.
 5. Maximum working pressure: 160 psig.
 6. Provide integral heat traps.
 7. Provide drain pan.
- I. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

2.7 VACUUM RELIEF VALVES

- A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.
- B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

2.8 IN-LINE CIRCULATORS

- A. Manufacturers:
 - 1. Bell and Gossett
 - 2. Taco
 - 3. Aurora
 - 4. Armstrong
 - 5. Grundfos
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 80 psig, 150 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed on shaft.
- E. Bearings: Two, oil lubricated bronze sleeve, integral thrust collar.
- F. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- G. Drive: Flexible coupling.
- H. CP-1, 1/6 HP or as scheduled and fitted with remote heat sensing aqua-stat and timer.
- I. Aqua-stat: Honeywell – Model L4006A1009 (100 – 240 degree range) or approved equal by Johnson Controls and Dayton.
- J. Timer: Armstrong – Model 810233-130 or approved equal by Taco, Bell and Gossett, Grundfos, or Armstrong

2.9 T & P RELIEF VALVES

- A. Manufacturers: Watts Industries or approved equal.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
 - 1. Watts N36 Lead Free Series.

2.10 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers: Bell & Gosset PT Series or approved equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.
- D. Provide separate support to structure for expansion tank

2.11 GARBAGE DISPOSAL

- A. Insinkerator Model 444, 120V, 3/4 HP, provide all trim and accessories for City approved installation.

2.13 GREASE TRAP

- A. Manufacturer:
 - 1. Schier GB Series
- B. The Basin™ grease interceptor shall be lifetime guaranteed and seamless, rotationally molded polyethylene. Interceptor shall be furnished for above or below grade installation. Interceptor shall be certified to ASME A112.14.3 (type C) and CSA B481.1, with field adjustable riser system, built-in flow control, built-in test caps and three outlet options. Interceptor flow rate shall be (20, 25, 35, 50, 75, 100) GPM. Interceptor grease capacity shall be (64, 70, 127, 130, 175, 249, 272, 653, 1751) lbs. Cover shall provide water/gas-tight seal and have minimum 16,000 lbs. load capacity.
- C. Performance: The inlet diffuser splits influent into three paths, creating laminar flow and utilizing the entire liquid volume of the tank for efficient grease separation. The calibrated openings greatly reduce effluent turbulence. The effluent enters the main chamber without disturbing the existing grease or sediment layers.
- D. Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48-76 Class 30. Manhole shall be nominal 24-inch diameter and be traffic duty and gas-tight access covers.
- E. Provide an approved sampling well connection.

2.17 WATER SOFTENERS (WS-1)

- A. Provide water softening equipment to remove hardness (calcium carbonate) to the extent that the effluent from the water softener, under operating conditions, shall contain zero grains per gallon of hardness as determined by an accepted titration hardness test method.
- B. Guarantee:
 - 1. That the loss of ion exchange resin through attrition during the first three (3) years of operation shall not exceed three (3) percent per year.
 - 2. That the resin shall not be washed out of the system during the service run of backwashing period.
 - 3. That the turbidity and color of the effluent, by reason of passing through the softener system, shall not be greater than the incoming water.

- C. Tank:
 - 1. Design tanks for working pressure of 100 psi.
 - 2. Tanks shall be fiberglass reinforced polyester.
- D. Brine System:
 - 1. Provide a combination salt storage and brine measuring tank with cover.
 - a. Large enough to hold salt for at least four generations at full salting.
 - b. Tank shall be constructed of molded white polyethylene with cover.
 - 2. Equip the brine tank with:
 - a. A float operated, plastic fitted, field serviceable brine valve for automatic control of brine withdrawal and freshwater refill.
 - b. The brine valve shall provide positive shut-off to prevent air from entering the system.
- E. Softener Tanks:
 - 1. Shall consist of (2) two modules as shown on drawings.
- F. System Manufacturer Star-Up Service:
 - 1. Provide the services of factory trained service technicians to start up the system.
 - a. Technicians shall be trained and experienced on the work they conduct.
 - 2. Monitor the operation of the softener.
 - 3. Follow the manufacturer's start up procedures.
 - a. Provide appropriate programming of the electronic programmable control.
 - 4. During the test and start up procedure, concurrently instruct the owner's operating personnel.
- G. Instructions:
 - 1. Provide a complete set of instructions covering the installation, operation and servicing of the water softener and programming of the controls.
 - 2. Insert in the Owner's manual.
- H. Water Testing Equipment:
 - 1. Provide a sample cock installed for obtaining samples of the effluent water.
 - 2. Provide a complete water testing kit for conducting a hardness test.
- I. Capacity:
 - 1. The water softening equipment shall have the capacity of following 60 GPM with a pressure loss not to exceed 15 PSI for each unit. Provide unit with a minimum capacity of 150, 000 grains and 5 cubic feet of resin.
- J. Installation:
 - 1. All piping shall be type "L" copper.
 - 2. Arrange piping for easy dismantling to permit cleaning and service.
 - 3. Install the system in accordance with the manufacturers "installation, start-up and service instructions".
- K. Submittals:
 - 1. Submit shop drawings and product data as specified.
 - 2. Submit manufacturer's certified capacity data.
 - 3. Submit manufacturer's "installation, start-up and service" instructions.
- L. Acceptable Manufacturers:
 - 1. Mueller

2. Unity
3. Watertech
4. Bruner
5. Marlo

2.20 SINK PLASTER TRAP

- A. Manufacturer: Striem Sidekick
- B. Construction: Fabricated Steel Body and Cast-Iron Cover with Galvanized Sub-Coat with White Duco Finish Inside and Outside and Stainless-Steel Perforated Bucket.
- C. Coordinate installation with Architectural casework installer, allow adequate room for bucket removal.

2.24 SAND/OIL SEPARATOR

- A. Manufacturers:
 1. Striem OT Series
- B. Concrete: Class 1 concrete with design strength of 4500 PSI at 28 days. Unit is a monolithic construction at floor, first stage of wall and baffle with sectional riser to required depth. (Rated for H-20 loading)
- C. Reinforcement: Grade 60 reinforced with steel rebar conforming to ASTM A615 on required centers or equal.
- D. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A536, AASHTO M306, and AASHTO M105 standard manhole. Manhole shall be nominal 24-inch diameter and be traffic duty and gas-tight access covers.
- E. Accessories: High oil float switch with High oil alarm panel for remote mounted (120 VAC).
- F. Provide an approved sampling well connection.

2.25 SOLIDS INTERCEPTOR (AT CTE)

- A. Manufacturers:
 1. Striem AA Series
- B. Concrete: Class 1 concrete with design strength of 4500 PSI at 28 days. Unit is a monolithic construction at floor, first stage of wall and baffle with sectional riser to required depth. (Rated for H-20 loading)
- C. Reinforcement: Grade 60 reinforced with steel rebar conforming to ASTM A615 on required centers or equal.
- D. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48-76 CLASS 35. Manhole shall be nominal 24-inch diameter and be traffic duty and gas-tight access covers.
- E. Accessory: Removable stainless-steel filter screen.

2.26 AIR COMPRESSOR

- A. (AC-1): Champion Model No. VR10-12 (10HP/460/3/60) with vertical 120-gallon receiver with 10 HP compressor capable of delivering 39CFM @ 175 PSIG. Unit to be furnished with air dryer (115/1/60) with a flow capacity of minimum CFM complimentary to the specified air compressor. Coordinate with Electrical for electrical requirements. Provide unit with all motor control components including starter.
- B. Accessories:
1. Inlet-Air Filter: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
 - a. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 - b. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.
 2. Flexible Connectors:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Flex-Hose Co., Inc.
 - (2) Flexicraft Industries.
 - (3) Hyspan Precision Products, Inc.
 - (4) Mercer Rubber Co.
 - (5) Metraflex, Inc.
 - (6) Proco Products, Inc.
 - (7) Unaflex, Inc.
 - (8) efacqc
 - b. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - (1) Working-Pressure Rating: [**200 psig**] [250 psig] minimum.
 - (2) End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
 - (3) End Connections, NPS 2-1/2 and Larger: Flanged steel nipple
 3. Filters: (10 scum – 170 SCFM)
 - a. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration and drain cock. [**Include mounting bracket if wall mounting is indicated.**]
 - b. Coalescing Filters/Regulator: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. [**Include mounting bracket if wall mounting is indicated.**]

2.27 OVERHEAD AIR HOSE REEL (HR-X)

- A. Overhead air hose reel with 50' ½" air hose. Model: Balcrank 2111-036.

2.28 SAMPLING WELL

- A. Manufacturer: Manufacturer: Striem, Schier, ParkUSA Equipment
- B. Construction:
1. Concrete: Class 1 concrete with design strength of 4500 PSI at 28 days. Unit is of monolithic construction at floor and first stage of wall with sectional riser to required depth.

2. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM A48 Class 30. Manhole shall have 15 inch inside diameter and be traffic duty AASHTO H-20 and gas-tight access covers.

2.29 DRY WELL

- A. Manufacturer: Oldcastle, Wieser Concrete, Columbia Precast, or Harris Precast
- B. Capacity:
 1. 24" Dia. x 24" (50 gallon)
 2. 30" Dia. x 30" (80 gallon)
 3. 36" Dia. x 36" (150 gallon)
 4. 48" Dia. x 30" (220 gallon)
 5. 48" Dia. x 42" (320 gallon)
 6. 48" Dia. x 54" (400 gallon)
 7. 48" Dia. x 66" (500 gallon)
- C. Construction:
 8. Concrete: ASTM C478 concrete with design strength of 5000 PSI at 28 days. Unit is of monolithic construction at floor and first stage of wall with sectional riser to required depth. Bottom shall have opening center of base.
 9. C.I. Castings: Manhole frames, covers or grates are manufactured of grey cast iron conforming to ASTM -C478. All manhole joints sealed with mastic or rubber gasket.

2.30 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers
 1. Comply with ASSE 1013.
 2. Bronze body, with bronze internal parts and stainless-steel springs.
 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
 4. Manufacturers:
 - a. Febco 825Y.
 - b. Hersey FRP II
 - c. Wilkins 975.
 - d. Watts Series LF909, or approved equal
- B. Double Check Valve Assemblies:
 1. Comply with ASSE 1012.
 2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
 3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.
 4. Manufacturers:
 - a. Febco 815.
 - b. Hersey BCP
 - c. Wilkins 760.
 - d. Watts Series 9D or approved equal.
- C. Dual Check Valves:

1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.
3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
4. Manufacturers:
 - a. Wilkins 740.
 - b. Watts Model SD-2/9BD, or approved equal

D. Lead Free

2.31 WATER PRESSURE REGULATING VALVES

- A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
 1. Sizes 1/2" through 2"
 2. All bronze body
 3. 0.25% maximum weighted average lead content
 4. Integral stainless-steel strainer screen
 5. Built-in bypass check valve
 6. FDA approved elastomers
 7. Renewable seat
 8. Union end connection
 9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
 10. Manufactured by Wilkins Series 600XL or approved equal by Watts
- B. Large Demand Systems
 1. Sizes 1-1/4" through 2 - ASTM B62 bronze body
 2. Sizes 2-1/2" and larger - ASTM A536 ductile iron body
 3. Pressure reducing pilot control
 4. Stainless steel disc guide, seat and bearing cover
 5. Stainless steel stem, nut and spring
 6. FDA approved Nylon reinforced Buna-N rubber diaphragm
 7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
 8. Cla-Val Company Series 90 or approved equal by Watts

2.32 WATER HAMMER ARRESTORS

- A. Manufacturers: Watts Series LF15M2 Series or approved equal.
- B. ANSI A112.26.1; copper construction, piston type sized in accordance with PDI WH-201.
- C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.
- D. Access Panel: Acorn Model 8292 or approved equal.
- E. Lead Free.

2.33 THERMOSTATIC MIXING VALVES:

- A. Manufacturers:
 - 1. Leonard.
 - 2. Acorn controls.
 - 3. Power.
 - 4. Bradley.
 - 5. Zurn/Wilkins.
- B. Certified to ASSE Standard 1017, ASSE 1070, and meets the anti-scald requirements of ASSE Standard 1016.
- C. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
- D. Capacity:
 - 1. TMV-1: Flow capacity between 0.35 gpm Min. and 4 gpm Max. at 5 psi pressure drop. Lead Free.
 - a. Model:
 - (1) Lawler 1070 Series
 - (2) Leonard – 170-LF
 - (3) Acorn controls - ST70CP-38
 - (4) Power - LFLM495
 - (5) Zurn/Wilkins – ZW3870XLT-4P
 - 2. TMV-2: 3 gpm Min. and 14 gpm Max. at 5 psi pressure drop. Lead Free
 - a. Model:
 - (1) Lawler 66-25
 - (2) Leonard – LV-186-982-LF-STSTL-REC.
 - (3) Acorn controls – SFMV Series
 - (4) Power – ETV200
 - (5) Bradley – TMV-25
 - 3. TMV-3: 3 gpm Min. and 30 gpm Max. at 5 psi pressure drop. Lead Free
 - a. Model:
 - (1) Lawler 66-80
 - (2) Leonard – LV-186-983-LF-STSTL-REC.
 - (3) Acorn controls – SFMV Series
 - (4) Power – ETV200
 - (5) Bradley – TMV-80
- E. Accessories:
 - 1. Check valve on inlets.
 - 2. Volume control shut-off valve on outlet.
 - 3. Stem thermometer on outlet.
 - 4. Strainer stop checks on inlets.
- F. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.
- G. Mechanical Rooms: Omit cabinet, surface mount.
- H. Mount:
 - 1. TMV-1 in piping under lavatory/sink/etc.
 - 2. TMV-2 in wall mounted stainless steel cabinet.
 - 3. TMV-3 in wall mounted stainless steel cabinet
- I. Lead Free.

2.34 SOLENOID VALVES

- A. ASCO Series Next Generation
- B. Provide at each kitchen cooking hood and at each science lab prep room and demo table where for automatic gas supply shut-off.
- C. Coordinate electrical connections with Division 26.

2.35 FLOW METER

- A. Water meter
 - 1. Provide clamp-on ultrasonic water flow meter at the main water point of entry or as indicated on plan.
 - 2. Provide Onicon F-4300 meter with the followings.
 - a. Accuracy +/- 1.0% of reading from 1.6 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 1.6 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to 140°F
 - e. Power supply: 120VAC , 60 Hz, 10 VA max. .(provide transformer as needed)
 - f. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)
 - g. Digital communications: RS-232, RS-485, Modbus RTU
 - h. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - i. Standard cable length: 25 ft (9 m), Maximum cable length: 100 ft (30 m)
 - 3. Acceptable Manufacturers:
 - a. Sierra
 - b. Siemens
 - c. Dynasonics
 - d. Onicon
- B. Natural/Propane gas meter
 - 1. Provide insert mass flow meter at the main water point of entry or as indicated on plan.
 - 2. Provide Onicon F-5500 meter with the followings.
 - a. Accuracy +/- 0.5% of reading from 0.16 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 0.16 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to 140°F
 - e. Input power: 12-28 VDC, 6 W min.
 - f. Power supply: 120VAC , 60 Hz, 10 VA max.(provide transformer as needed)
 - g. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)
 - h. Digital communications: RS-232, RS-485, Modbus RTU
 - i. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - j. Standard cable length: 15 ft (9 m), Maximum cable length: 100 ft (30 m)
 - 3. Acceptable Manufacturers:

- a. Sierra
 - b. Thermal Instrument Co.
 - c. Dynasonics
 - d. Onicon
- C. Blowdown meter
 - 1. Provide 2" stainless steel water flow meter with pulse output at the cooling tower blow down line or as indicated on plan.
 - 2. Provide PRM # WM200SSVX meter with the followings.
 - a. Accuracy +/- 5.0% of transitional flow and +/- 2.0% normal flow
 - b. Process pipe-wall temperature: 32°F to 104°F
 - c. Flow range: 2-100 GPM.
 - d. Output signals:
 - (1) Pulse (configurable)
 - e. Materials:
 - (1) 304 Stainless steel
 - (2) Seal: Viton
 - f. Standard cable length: 10 ft (9 m), Maximum cable length
 - 3. Acceptable Manufacturers:
 - a. Stenner
 - b. EKM
 - c. Carlon Meter
 - d. PRM
- D. Warranty
 - 1. Products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to the owner, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery

2.36 TEMPERATURE INSTRUMENTS

- A. Manufacturer: Trerice, Taylor, Marsh, Weksler, Marshalltown, Weiss, or Miljoco.
- B. Thermometer Wells.
 - 1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
 - 2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
 - 3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
 - 4. Wells shall be sized to extend a minimum of 50% into pipe

2.37 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00
- B. Install water heater with the followings.

1. Maintain manufacturer's recommended clearances around and over water heaters.
2. Connect natural gas piping in accordance with NFPA 54.
3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.
4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
5. Install the following piping accessories.
 - a. On supply:
 - (1) Thermometer well and thermometer.
 - (2) Strainer.
 - (3) Pressure gage.
 - (4) Shutoff valve.
 - (5) Diaphragm-type expansion tank
 - b. On return:
 - (1) Thermometer well and thermometer.
 - (2) Pressure gage.
 - (3) Shutoff valve.
6. Install the following piping accessories on natural gas piping connections.
 - a. Strainer.
 - b. Pressure gage.
 - c. Shutoff valve.
 - d. Pressure reducing valve.
7. Install discharge piping from relief valves and drain valves to nearest floor drain.
8. Install circulator and diaphragm expansion tank on water heater.
9. Install water heater trim and accessories furnished loose for field mounting.
10. Install electrical devices furnished loose for field mounting.
11. Install control wiring between water heater control panel and field mounted control devices.

12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.
 13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.
- C. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
1. Install the following piping accessories.
 - a. On supply:
 - (1) Pressure gage.
 - (2) Shutoff valve.
 - (3) Check valve.
 - b. On return:
 - (1) Thermometer well and thermometer.
 - (2) Timer.
 - (3) Pressure gage.
 - (4) Shutoff valve.
- D. Water softener: Install system components according to manufacturer's published recommendations and pipe as indicated on Drawings. Care shall be exercised in fabricating plumbing lines to avoid all cross connections eliminate the possibility of water contamination.
1. Provide and install double check valve assembly backflow prevention on the potable water line serving the water softener downstream of all potable water connections serving any other outlets or equipment.
 2. Backflow preventers shall be duplexed where located within lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (twenty-four hour) water service is required.
 3. Provide a physical air gap of at least two times the diameter of the softener equipment drain piping discharging into a floor drain/sink receptor.
 4. Provide for the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation and acquaint the operators with the proper operation and maintenance of the equipment.
- E. Backflow Preventers and Vacuum Breakers.

1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.
 2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.
 3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.
 4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.
 5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.
 6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.
- F. Water Hammer Arrestors (Hydraulic Shock Absorbers).
1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.
 2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.
 3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.
- G. Water Pressure Regulating Valves.
1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.
 2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.
 3. Installation shall allow sufficient access to and space around components for adjustments and servicing.
 4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators
- H. Grease traps shall be cleaned and pumped prior to substantial completion. Interior joints shall be properly sealed.
- I. Install diaphragm-type expansion tank on cold water supply line.
- J. Install flow meter on cold water supply line and gas line at point of entry. Coordinate with div. 23 (BAS) for signal output and div. 26 for power requirements.

K. Sewer and Sump pump Discharge Piping:

1. Factory or field fabricated, galvanized, ASTM A53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flange and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.
2. Underground piping shall be Copper Tubing: ASTM B88, Type K. Fittings: ASME B16.22 wrought copper and bronze. Joints: AWS A5.8, BCuP silver braze.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete system of plumbing fixtures and trim.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.3 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.5 EXTRA MATERIALS

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

- A. Fixture Manufacturers:
 - 1. American Standard

2. Zurn
3. Kohler
- B. Fixture Trim Manufacturers:
 1. Sloan
- C. WC-1: ASME A112.19.2M; wall hung, siphon jet vitreous China closet bowl, with elongated rim, 1-1/2-inch top back spud, China bolt caps.
 1. Wall Mounted: American Standard 3351.101.020
 2. Or as indicated on schedules.
 1. Trim: Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal or Sloan 111-1.28 (standard), Sloan 115-1.28 DFB (ADA).
- D. WC-2: Same as WC-1, except mounted at ADA/TAS height for appropriate age group.
 1. Wall Mounted: American Standard 3351.101.020
 2. Or as indicated on schedules.
 3. Trim: Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal (ADA), Sloan 115-1.28 DFB (ADA).
 4. Provide flush valve stem offset as required.
- E. Seat: White plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, and Church. Bemis 1655SSCT or provide as indicated on plumbing fixture schedule.
- F. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Jay R. Smith 200 series carriers, or equal by zurn and watts.

2.2 WALL HUNG URINALS

- A. Fixture Manufacturers:
 1. Toto
- B. Fixture Trim Manufacturers:
 1. Sloan.
- C. All urinal flush valves shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. U-1: Toto UT104E#01. ASME A112.19.2M; vitreous china, wall hung, elongated rim integral trap, removable stainless-steel strainer, 3/4 inch top spud, provide chair carrier as required.
 1. Trim: Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, integral screwdriver stop with vandal resistant stop cap, vacuum breaker; maximum one (1) pint flush volume. Sloan Model Royal. Sloan Flushometer 186-0.125 DBP.

- E. U-2: Same as U-1, except mounted at ADA/TAS height for appropriate age group.
 - 1. Trim: Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, integral screwdriver stop with vandal resistant stop cap, vacuum breaker; maximum one (1) pint flush volume. Sloan Model Royal. Sloan Flushometer 186-0.125 DBP.
- F. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with rectangular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. Provide bottom bearing plate. Jay R. Smith figure 0637, or equal by Zurn and watts or provide as indicated on plumbing fixture schedule.

2.3 LAVATORIES

- A. Fixture Manufacturers:
 - 1. American Standard
 - 2. Kohler
 - 3. Zurn
 - 4. Toto
 - 5. Sloan
- B. Fixture Trim Manufacturers:
 - 1. Sloan
 - 2. Chicago.
- C. Supply Fittings Manufacturers:
 - 1. Chicago.
 - 2. McGuire.
 - 3. Brasscraft.
 - 4. Zurn.
- D. All lavatory faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- E. L-1, ASME A112.19.2M; American Standard 0356.028.020 or equal vitreous China wall hung lavatory 21 x 15 inch minimum, with four (4) inch high back, 3 deck holes, rectangular basin with splash lip, front overflow, and soap depression. Provide floor mounted carrier for correct lavatory type.
 - 1. Trim: Supply Fitting: ASME A112.18.1 (Type F2); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucets Model 857-E2805-665PSHAB.
- F. L-2, Same as L-1, except mounted at ADA/TAS height for appropriate age group.
 - 1. Trim: Supply Fitting: ASME A112.18.1 (Type F2); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy

aerator with 0.5 gpm flow, ADA compliant. Chicago Faucets Model 857-E2805-665PSHAB.

- G. Accessories:
1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 2. Chrome plated 17 gage open grid P. O. plug.
 3. Removable key stops.
 4. Flexible supplies.
 5. Trap and waste insulated and offset to meet ADA compliance.
 6. Tempering valve – Power LFe480 series, Acorn, or Leonard.
- H. Floor Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs. Jay R. Smith 710 Series, or equal by Zurn and watts.

2.4 SINKS

- A. Fixture Manufacturers:
1. Elkay Mfg.
 2. Just
- B. Fixture Trim Manufacturers:
1. Chicago Faucet Co.
- C. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- D. All sink faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- E. SK-1: Single Compartment Bowl: ASME A112.19.3; 19-1/2 x 19-1/2" x 6-1/2 inch outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ191965PD.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP.
- F. SK-2: Double Compartment Bowl: ASME A112.19.3; 33 x 19-1/2 x 6-1/2 inch outside dimensions 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with

- 1-1/2 inch chromed brass stainless steel drains 3-1/2 inch crumb cups and tailpieces, ledge back drilled for trim. Elkay Model LRADQ331965PD.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP.
- G. SK-3: Single Compartment Bowl: ASME A112.19.3; 25" x 21-1/4" x 6-1/2" outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ252165PD.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, vandal proof water economy aerator with 0.5 gpm flow, 8" fixed center, 4" vandal proof Wrist blade Chicago Faucet Model 201-G8AE2805F317AB.
- H. SK-3D: Single Compartment (Deep) Bowl: ASME A112.19.3; 25" x 21-1/4" x 10-1/8" outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model DLR252110PD.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, vandal proof water economy aerator with 0.5 gpm flow, 8" fixed center, 4" vandal proof Wrist blade Chicago Faucet Model 201-G8AE2805F317AB.
- I. SK-4: Single Compartment Bowl: ASME A112.19.3; 16-3/4" x 15-1/2" x 6" outside dimensions, 20 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Advanced Tabco Model #7-PS-50 ADA or provide as indicated on plumbing fixture schedule.
1. Trim: Included with faucet. Wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. Vandal resistant aerator standard with 1.5 GPM, chrome plate brass with quarter turn ceramic disc valve and requires 2 faucet.
 2. Provide at commercial/culinary ADA handwash sink locations.
- J. SK-5: Single Compartment Bowl floor mount: ASME A112.19.3; 39" x 27-1/2" x 14" outside dimensions, 14 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model WNSF81362.
1. Trim: (Type L3) ASME A112.18.1; Wall mounted with adjustable arms 7-1/4"- 8-3/4", chrome plated, L-Type swing spout, 9-1/2" center to center, 1.5 GPM pressure compensating softflow aerator, vandal proof, ceramic quarter-turn cartridge, and integral stop valves for servicing the faucet. Chicago Faucet Model 640-L9E35-369YAB.
- K. SK-6: Double Compartment Bowl floor mount w/ drainboard at right hand side: ASME A112.19.3; 73"-1/2" x 27-1/2" x 14" outside dimensions, 14 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model WNSF8248R2.
1. Trim: (Type L3) ASME A112.18.1; Wall mounted with adjustable arms 7-1/4"- 8-3/4", chrome plated, L-Type swing spout, 9-1/2" center to center, 1.5 GPM pressure compensating softflow aerator, vandal proof, ceramic quarter-turn cartridge, and integral stop valves for servicing the faucet. Chicago Faucet Model 640-L9E35-369YAB.
- L. SK-7: Single Compartment Bowl: 20 gauge type 304 stainless steel (15-1/4" x 15-3/4" x 41") with special polished satin finish, foot operated system, removable front cover for easy installation and plumbing access, no lead faucet, ETL Certified, foot operated valve

faucet, soap dispenser & strainer. Provide GSW-USA HS-1615F w/ one (1) additional stock of replacement part AA-202G.

1. Trim: foot operated system integral to the specified fixture.

M. Accessories:

1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
2. Chrome plated 17 gage brass basket strainer.
3. Removable key stops.
4. Flexible supplies.
5. Trap and waste insulated and offset to meet ADA compliance.

N. Provide offset waste on all sinks.

O. At sinks indicated to **"PROVIDE PULL DOWN SPRAY MANUAL FAUCET"** the Contractor shall provide:

1. Chicago Faucets 434-ABCP; Deck-mounted high arc faucet with pull-down spout, single-hole mount (provide sink basin with appropriate deck hole quantities accordingly).

2.5 LAVATORY and SINK INSULATION KIT

A. Manufacturers:

1. Truebro/IPS
2. Plumberex
3. Zurn

B. Product Description: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

2.6 SHOWERS (Regular) – (SH-1)

A. Manufacturers:

1. Chicago Faucet Co.
2. Acorn Engineering Company.
3. Speakman.
4. Leonard Valve Co.
5. Symmons
6. Powers

B. SH-1: ASME A112.18.1; concealed shower supply with pressure balanced or thermostatic mixing valves, integral service stops, chrome plated vandal-proof institutional head with integral wall mounting flange, built-in 1.5 gpm flow, and

escutcheon. Acorn – SV16-LVR – 519 - MSH - F1.5 or provide as indicated on plumbing fixture schedule.

2.7 SHOWERS (ADA) – (SH-2)

- A. Manufacturers:
 - 1. Acorn Engineering Company.
 - 2. Powers.
 - 3. Approved equal.
- B. SH-2 ADA: ASME A112.18.1 and ASSE 1016-2011; concealed shower supply with pressure balanced and thermostatic mixing valves, integral service stops, hand held shower () with 69 inch metal clad hose and 24 inch glide mounted on right hand side (), flow rate 1.5 GPM. ACORN – SV16-LVR – HHC15 - HHSH - HHSE - IVB – SB – PK or provide as indicated on plumbing fixture schedule.

2.8 ELECTRIC DRINKING FOUNTAIN

- A. Manufacturers:
 - 1. Elkay Mfg.
 - 2. Halsey Taylor
 - 3. Oasis Corp.
- B. Supply Fittings Manufacturers:
 - 1. Chicago.
 - 2. McGuire.
 - 3. Brasscraft.
 - 4. Zurn.
- C. All electric water coolers shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. Fountain: (EDF-2) SINGLE UNIT Indoor With Bottle Filler
 - 1. ARI 1010; (ADA) Hydroboost bottle filling station, single cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Halsey Taylor Model HTHB-HAC8SS-NF.
 - 2. Capacity: 7.6 gph of water with inlet at 80 degrees F and room temperature of 90 degrees Fahrenheit.
 - 3. Electrical: 115V / 60HZ. Maximum 1/5 hp compressor, cord and plug for connection to electric wiring system including grounding connector.
 - 4. Provide cane touch apron, Halsey Taylor Model 42522 for HAC Series or provide as indicated on plumbing fixture schedule.

- E. Fountain: (EDF-3) BI-LEVEL UNIT Indoor With Bottle Filler
 - 1. ARI 1010; (ADA) Hydroboost bottle filling station, bi-level cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Halsey Taylor Model HTHB-HAC8BLSS-NF.
 - 2. Capacity: 7.6 gph of water with inlet at 80 degrees F and room temperature of 90 degrees Fahrenheit.
 - 3. Electrical: 115V / 60HZ. Maximum 1/5 hp compressor, cord and plug for connection to electric wiring system including grounding connector.
 - 4. Provide cane touch apron, Halsey Taylor Model 42522 for HAC Series or provide as indicated on plumbing fixture schedule.

2.9 EMERGENCY COMBINATION SHOWER WITH EYE AND FACE WASH (EW-#)

- A. Manufacturers:
 - 1. Guardian Safety Equipment
 - 2. Speakman
 - 3. Or approved equal
- B. Barrier Free, all stainless steel construction, corrosion resistant, combination eye/face wash and shower safety station with stainless steel shower head, stainless steel bowl, stainless steel flag handle and floor flange, 1 ¼" IPS Schedule 40 stainless steel pipe and fittings, 1" IPS and ½" IPS U.S. made stainless steel stay open ball valves, and polished stainless steel pull rod. Unit shall have (4) polypropylene 'GS Plus' spray heads with integral "flip-top" dust covers, filters, and 1.8-GPM flow control orifices mounted on a stainless steel head assembly. Unit shall include ANSI compliant sign.
- C. Performance: Unit complies with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed ANSI Z358.1 – 2004, and come with a full 2-year warranty.
- D. Fixture:
 - 1. (EW-1): Guardian Equipment GBF1994 or provide as indicated on plumbing fixture schedule.
 - 2. (EW-2): Guardian Equipment GBF 2150SSH-PCC for all Classrooms where recessed is possible (and where ceilings are provided).
 - a. Where ceilings are exposed and a chase is shown on the plans (with piping routed within the chase), provide GBF2170
 - 1) Example: INTRO WELDING LAB E101
 - b. Where ceilings are exposed and a chase is not shown on the plans (with piping routed within wall), provide GBF2173
 - 1) Example: CARPENTRY LAB 205A, ENGINEERING 201A
- E. Alarm Option:
 - 1. AP275-200 alarm unit, with light and horn. (blue color light) Light and horn shall be installed in corridor outside of science lab (120 VAC, 0.5 AMP).

2. Locate the blue light in the ceiling of the main corridor area directly outside room where emergency shower is installed. Provide one light per shower/valve configuration. Guardian AP280-235 (120v/1/60hz – 0.11 amp) for GBF 2150SSH-GC and Guardian AP280-230 (120v/1/60hz – 0.11 amp) for GBF 1909SSH-GC
- F. Hot water Option: TMV G3800LF Thermostatic mixing valve per ANSI Z358.1-2014.
- G. Supply and Waste Piping: 1-1/4 inch galvanized steel pipe pedestal with floor flange.
- H. Furnish universal emergency sign.

2.10 SERVICE SINKS (SS)

- A. Manufacturers:
 1. Fixture Manufacturers:
 - a. Fiat Products
 - b. Florestone
 - c. Stern Williams
 2. Fixture Trim Manufacturers:
 - a. Chicago Faucet Co.
 - b. Fiat Products
 - c. Stern Williams
 - d. T & S Brass & Bronze Works Inc.
- B. SS-1: Acid-resistant, 12" corner type w/drop front, bowl 32 x 32 x 12 inch high. Receptor composed of acid-resistant pearl grey marble chips and acid-resistant white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer, floor mounted. Stern Williams Model SBC-1725 or provide as indicated on plumbing fixture schedule.
- C. SS-FLORAL: Site built (by Architect) floor basin with water protective flashing, refer to Architectural/Structural for additional information. Provide and install 3" FD – 2 at center of basin. Provide and install T&S Brass B-0610 pot filler (wall-mounted, 8" centers, vacuum breaker, lead-free, 68" flexible stainless-steel hose, spray valve with self-closing hook nozzle) and certified to ASME A112.18.1, NSF 61, NSF 372, ASSE1001.
- D. Accessories:
 1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.
 2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.
 3. Mop hanger. Stern Williams Model T-40.
 4. Or provide as indicated on plumbing fixture schedule

2.11 FLOOR DRAINS

- A. Manufacturers:

1. Josam Mfg.,
 2. Jay R. Smith Mfg.,
 3. Wade Spec. Products
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.
- C. Floor Drain (FD-2): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable light duty square nickel-bronze strainer with removable perforated sediment bucket. Zurn ZN-415N-P (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.
- D. Floor Drain (FD-3): ASME A112.21.1; Cast iron flanged receptor with seepage holes, acid resistant coated interior and indirect waste drain, nickel bronze rim and secured grate. Secondary strainer or sediment bucket with. Zurn ZN-1970-KC-11 (Vandal-Proof Secured Top) with 4" funnel drain for freezer drain only or provide as indicated on plumbing fixture schedule.

2.12 FLOOR SINKS

- A. Manufacturers:
1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Wade Spec. Products
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. Floor Sink (FS-1): Cast iron body with integral seepage pan, acid resistant interior, nickel bronze rim and secured 1/2 grate. Aluminum dome bottom strainer and eight (8) inch square top. Zurn ZN-1910-K Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.
- C. FS-2: Zurn ZN-1900-KC, 12 inches, 3/4 grate (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.
- D. FS-3: Zurn ZN-1900-KC, 12 inches, 1/2 grate (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.13 TRAP SEAL PRIMERS

- A. Manufacturers:
 - 1. PPP Inc.
 - 2. Wade
 - 3. Sioux Chief
 - 4. Zurn
 - 5. Mifab
 - 6. Watts
 - 7. Sloan
- B. Trap Seal Primers-Pressure Drop Type (TP-1)
 - 1. Adjustable to the static line pressure by use of the adjusting screw. System operating range is 20 psi minimum to 80 psi. The trap Primer is to be connected to a cold water supply with isolation valve.
 - a. PPP Model P1-500 will prime 1-4 floor drains using DU-U Distribution unit.
 - b. PPP Model P2-500 will prime 1-2 floor drains using DU-U Distribution unit.
- C. Trap Seal Primers-Flush Valve Type (TP-2)
 - 1. Vacuum breaker trap primer attached to water closet flush valve, similar to Sloan VBF-72-A.
- D. Trap Seal Primer: (TP-3), Jay R. Smith 2699 Series.
- E. Trap Seal Primers-electronic Type (TP-E)
 - 1. Vacuum breaker trap primer attached to water supply manifold, similar to Zurn Z-1020 with copper waterway.
 - 2. Accessories:
 - a. Slow closing 24 VAC solenoid valve.
 - b. 120 – 24 VAC transformers.
 - c. Brass atmospheric vacuum breaker.
 - d. Copper connection outlets

2.14 TRAP GUARDS

- A. Provide trap guards (TG-X) inline floor drain trap sealer to be manufactured the Green Solution Sure seal Vent Guard, Model #SSX009V. (X = 2 for 2"; 3 for 3"; 4 for 4").
- B. **ONLY PROVIDED AT LOCATIONS WHERE P-TRAPS ARE AT EXTERIOR OF BUILDING AND SUBJECT TO FREEZING CONDITIONS. HUFFMAN ISD PREFERENCES IS TRAP PRIMERS AT ALL OTHER P-TRAPS.**

2.15 TRENCH DRAIN

- A. Design: Provide the following type of drain systems.
 - 1. Manufacturers:

- a. Josam
 - b. Zurn
 - c. JR Smith
 - d. Mifab
 - e. Duratrench
 - f. Wade
 - g. ABT, Inc.
- B. TD-1: (Stainless Steel General and Shower Area)
 1. Design: Provide the following type of drain systems.
 - a. 2" Wide and 5" body 14ga type 304 stainless steel ADA shower drain.
 - b. Model J R SMITH 9666 or approved equal.
 2. Provide a complete drain system made up of selected components that together shall make a functional trench drain system. Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 3. Channel Sections: Interlocking joint, stainless steel with level invert.
 - a. Dimensions: 2-inch (102-mm) inside width. Include number of units required to form total lengths indicated.
 4. Grates: Manufacturer's designation "[**heavy**] [**medium**] duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - a. Material: Stainless steel.
 - 1) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 5. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.16 CLEANOUTS

- A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
 1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers
- B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.
- C. Manufacturers:
 1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Wade Spec. Products
 4. Zurn Industries
 5. Mifab
 6. Watts

- D. Floor, Outdoors (COTG or DCOTG): Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.
- E. Floor, Indoors (FCO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 – F-C-U.
- F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420-U.
- G. Floor, Stainless Steel Indoors (FCO-SS): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

2.17 ROOF DRAINS

- A. Roof Drain (RD-1):
 - 1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Removable aluminum dome with vandal proof screws.
 - 4. Accessories: Coordinate with roofing type, provide all required accessories:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Under deck ring with wide flange.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
 - 5. Model:
 - a. Josam – 21500-AE-CR-1-26
 - b. J. R. Smith – 1015AD-C-R
 - c. Zurn – ZA100-C-EA-R
 - d. Wade – 3000-AE-189
 - e. Mifab – R1200-EU-B-M-80
- B. Overflow Roof Drain (OD-1):
 - 1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Removable aluminum dome with vandal proof screws.
 - 4. Waterdam extended to two (2) inches above flood elevation.
 - 5. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
 - 6. Model:

- a. Josam – 21500-AE-CR-1-26
- b. J. R. Smith – 1015AD-C-R
- c. Zurn – ZA100-C-EA-R
- d. Wade – 3000-AE-189
- e. Mifab – R1200-EU-B-M-80

C. All roof drains shall be provided with no-hub connection.

2.18 HOSE BIBS

- A. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Woodford
 - 4. Zurn Industries
 - 5. Chicago
 - 6. Wade
- B. HB-1:
 - 1. Manufacturers: Woodford Model B24 or provide as indicated on plumbing fixture schedule.
 - 2. Interior: Polish brass, anti-siphon, vacuum breaker, enclosed in flush mounted wall box and adjustable brass nut with deep stem guard.
 - 3. At KENNELS where a reel is specified, provide and install Chicago Faucets 537-WCNF and mount above hose bibb.
- C. HB-2:
 - 1. Manufacturers: Woodford Model B65, or provide as indicated on plumbing fixture schedule.
 - 2. Interior: Polish brass Bronze, automatic draining freezeless wall hydrant, single check hose connection anti-siphon vacuum breakers, hydrants drain as handle shut off , permanent type brass valve body with hemispherical seating surface.
- D. HB-3:
 - 1. Manufacturers: Woodford Model 24 or provide as indicated on plumbing fixture schedule.
 - 2. Interior: Polish brass, anti-siphon, vacuum breaker and adjustable brass nut with deep stem guard.

2.19 WALL HYDRANTS

- A. Manufacturers:
 - 1. Josam Mfg.

2. Jay R. Smith Mfg.
 3. Woodford.
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. Exterior Wall Hydrant (WH-1):
1. Woodford RB65, Non-Freeze, or provide as indicated on plumbing fixture schedule.
 2. ASSE 1019; Chrome, non-freeze, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker.

2.20 RECESSED VALVE BOX

- A. Manufacturers: Guy Gray, or approved equal.
- B. RVB-1, Refrigerator/Ice Machine: Stainless steel preformed rough-in box with brass valves with wheel handle slip in finishing cover. IPS Model SSMIB8AB.
- C. RVB-2, Washing Machine: Galvanized steel preformed rough-in box with brass long shank valves with wheel handles, valves with single lever handle, socket for two (2) inch waste, slip in finishing cover. IPS Model SSWB-3.

2.21 DOWNSPOUT OVERFLOW

- A. Hinged Cover Style:
1. Manufacturers: Jay R. Smith 1775-U Series or provide as indicated on plumbing fixture schedule.
 2. Product Description: Fabricated Type 304 Stainless Steel Downspout Cover with Hinged Perforated Cover.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- F. For ADA accessible water closets, install flush valve with handle to wide side of stall.
- G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P or provide as indicated on plumbing fixture schedule.
- H. Ice maker: Provide floor sink and cold-water outlet RVB-1 to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- I. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- J. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- K. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- L. Washing Machine: Provide Hot and cold water outlet RVB-2 to each location. Coordinate with Architecture Drawings prior to rough-in.
- M. Provide power wiring, including control power transformers as required for all sensor type fixtures.
- N. Bolt carriers to the floor.
- O. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.4 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical

Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

- F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.5 DRAWINGS

- A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.6 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 - 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnish product named in Specification and or Drawings.
 - 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.7 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a

complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 - 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.

G. No substitutions will be considered after the Award of Contract.

1.8 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.9 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.11 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).
- C. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
 - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
 - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
 - 7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

- D. Refer to individual equipment specifications for additional training requirements.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation and include all costs for any required increases in electrical system.
- C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 – Motors and Generators.
- C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Baldor
 2. Marathon
 3. General Electric
 4. Weg
 5. A.O. Smith
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated.
- E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
1. Service Factor: 1.15
 2. Enclosure: Concealed Indoor: ODP, Exposed Indoor: Guarded ODP, Outdoor: Type II TEFC, Outdoor Weather Protected: Type I TEAO.
 3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Insulation System: NEMA Class F.
 5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 40,000 hours. Calculate bearing load with NEMA standard shaft extension. Stamp bearing sized on nameplate.
 7. Sound Power Levels: Conform to NEMA MG 1.
 8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.
- F. Single Phase Motors:
1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.

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2. Service Factor: 1.35.

G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:

1. Starters and motors specified as part of a packaged piece of equipment.
2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.
3. Variable speed controllers for variable volume air handling units and cooling towers.

B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.

C. Provide a tabulation of matched motors and starters provided under Division 23.

D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.

E. Efficiency: Minimum full load efficiency shall be as follows:

Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)			
	1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency	HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency
1	82.5	85.5	77.0	1	82.5	85.5	77.0
1.5	86.5	86.5	84.0	1.5	87.5	86.5	84.0
2	87.5	86.5	85.5	2	88.5	86.5	85.5
3	88.5	89.5	85.5	3	89.5	89.5	86.5
5	89.5	89.5	86.5	5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	7.5	91.0	91.7	89.5
10	91.7	91.7	89.5	10	91.0	91.7	90.2
15	91.7	93.0	90.2	15	91.7	92.4	91.0
20	92.4	93.0	91.0	20	91.7	93.0	91.0
25	93.0	93.6	91.7	25	93.0	93.6	91.7
30	93.6	94.1	91.7	30	93.0	93.6	91.7

40	94.1	94.1	92.4	40	94.1	94.1	92.4
50	94.1	94.5	93.0	50	94.1	94.5	93.0
60	94.5	95.0	93.6	60	94.5	95.0	93.6
75	94.5	95.0	93.6	75	94.5	95.4	93.6
100	95.0	95.4	93.6	100	95.0	95.4	94.1
125	95.0	95.4	94.1	125	95.0	95.4	95.0
150	95.4	95.8	94.1	150	95.8	95.8	95.0
200	95.4	95.8	95.0	200	95.8	96.2	95.4

PART 3 - EXECUTION

3.1 REQUIREMENTS

- A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor's price shall include all items required as per manufacturer's requirements.

3.2 INSTALLATION

- A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.
- B. Install rotating equipment in static and dynamic balance.
- C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 23 05 13

SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications. It is required that the drive manufacturer has an existing independent service organization.
- B. The drive and all necessary controls as specified herein shall be supplied by the drive Manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.
- C. For Air Handling Units with multiple fans (Fan Array) and motors, VFD manufacturer shall provide internal individual motor overloads to match quantity of fan motors. Refer to Air Handling Unit Schedule for fan motor quantity

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - 2. Underwriter's laboratories
 - a. UL508C
 - 3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS 7.0, AC Adjustable Speed Drives
 - 4. IEC 16800 Parts 1 and 2
- B. Testing:
 - 1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 degrees Fahrenheit at full rated load, on a motor. Drive input power shall be continuously cycled for maximum stress and thermal variation.
 - 2. All testing and manufacturing procedures shall be ISO 9001 certified.
- C. Failure Analysis:

1. VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.

D. Qualifications:

- a. VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Submit VFD's only after coordination with approved Air Handling Units, Pumps, and Cooling Tower Submittals (If applicable).
- C. All Variable Frequency Drives serving various equipment such as but not limited to: Air handling Units, Pumps and Cooling towers shall be supplied by the same manufacturer.
- D. Submittals shall include, as a minimum, the following information:
 1. Outline Dimensions
 2. Weight
 3. Compliance to IEEE 519 - harmonic analysis for particular job site including total harmonic voltage distortion and total harmonic current distortion.
 - a. The VFD manufacture shall provide calculations specific to the installation, showing total harmonic voltage distortion is less than five (5) percent. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior VFD installation.
 - b. If the voltage THD exceeds five (5) percent, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.5 WARRANTY

- A. The warranty shall be (2) two years and shall begin from date of Certificate of Substantial Completion. The warranty shall include all parts, labor, travel time and expenses to provide on-site warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in manufacturer's original, unopened containers with identification labels intact.
- B. The contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather,

moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.7 MANUFACTURERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. ABB.
 - 2. Danfoss.

PART 2 - PRODUCTS

2.1 ADJUSTABLE FREQUENCY DRIVES

- A. The adjustable frequency drives (VFD's) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure (NEMA 3R if outdoors or unconditioned space), completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
 - 1. Input 480 VAC +/- 10 percent, 3 phase, 48-63 Hz. The overvoltage trip level shall be 30 percent over the nominal, and the under-voltage trip level shall be 35 percent over the nominal voltage as a minimum.
 - 2. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
 - 3. Environmental operating conditions: 0 to 104 Degree Fahrenheit, 0 to 3300 feet above sea level, less than 95 percent humidity, non-condensing.
 - 4. Conditioned indoors enclosure shall be rated NEMA 1 and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
 - 5. VFD's located in un-conditioned spaces or outdoors shall have rated NEMA 3R enclosure and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
- B. All VFD's shall have the following features:
 - 1. All VFD's shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall

have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.

2. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand", the VFD will be started, and the speed will be controlled from the up/down arrows. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bump less transfer" of speed reference when switching between "Auto" and "Hand" modes and vice-versa.
3. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to ACS400-US-reprogram all parameters and customer interfaces for a particular application to reduce programming time.
4. The VFD shall have the ability to automatically restart after an over current, overvoltage, under voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.
6. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.
7. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
8. The customer terminal strip shall be isolated from the line and ground.
9. The drive shall employ current limit circuits to provide trip free operation:
 - a. The Slow Current Regulation limit circuit shall be adjustable to 150 percent (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
 - b. The Current Switch-off limit shall be fixed at 350 percent (minimum, instantaneous) of the VFD's normal duty current rating.
10. The overload rating of the drive shall be 110 percent of its normal duty current rating for one (1) minute in every ten (10) minutes. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

11. The VFD shall have an integral Line Reactor(s) to reduce the harmonics to the power line and to increase the fundamental power factor. The minimum impedance shall be three (3) percent.
12. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.
13. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.
14. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes.
15. The following operators shall be provided:
 - a. Bypass Hand-Off-Auto
 - b. Drive mode selector
 - c. Bypass mode selector
 - d. Bypass fault reset
16. The following indicating lights (LED type) shall be provided:
 - a. Power-on
 - b. External fault
 - c. Drive mode selected
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Automatic transfer to bypass selected
17. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes.
18. The following relay (form C) outputs from the bypass shall be provided.
 - a. Drive run

- b. Bypass run
 - c. Drive fault Bypass fault (motor overload or under load (broken belt))
 - 19. Automatic or manual bypass (field selectable)
 - 20. Manual or automatic bypass fault (field selectable)
 - 21. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure.
 - 22. Door interlocked pad lockable circuit breaker which will disconnect all input power from the drive and all internally mounted options.
 - 23. Fast acting semi-conductor fuses exclusive to the VFD - fast acting semi-conductor fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the Bypass will not be accepted.
 - 24. Class 10 or 20 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.
- C. All VFD's to have the following adjustments:
- 1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 - 2. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.
 - 3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 ma and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz. Process variables shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.
 - 4. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock) drive is to resume normal operation.
 - 5. One (1) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.
 7. Seven (7) programmable preset speeds.
 8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.
 9. The VFD shall Ramp or Coast to a stop, as selected by the user.
- D. The following operating information displays shall be standard on the VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
 2. Motor Speed (RPM, percent, or Engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power (kW)
 6. DC Bus Voltage
 7. Output Voltage
 8. Heat sink Temperature (0°F)
 9. Analog Input Values
 10. Analog Output Value
 11. Keypad Reference Values
 12. Elapsed Time Meter (resettable)
 13. kWh meter (resettable)
 14. mWh meter
 15. Digital input status
 16. Digital output status
- E. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).

1. Over current trip 350 percent instantaneous (170 percent RMS) of the VFD's variable torque.
 2. Current rating.
 3. Overvoltage trip 130 percent of the VFD's rated voltage.
 4. Under voltage trip 65 percent of the VFD's rated voltage.
 5. Over temperature +90 degrees Celsius.
 6. Ground Fault either running or at start.
 7. Adaptable Electronic Motor Overload (1 2 t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL approved for this function.
- F. Speed Command Input shall be via:
1. Keypad.
 2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
 3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.
 4. Serial Communications
- G. Serial Communications
1. The VFD shall have an RS-485 port as standard. The standard protocol shall be BACnet. Optional protocols that must be available are Johnson Controls N2 bus, Siemens Building Technologies FLN, LonWorks, Profibus and DeviceNet.
 2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.
 3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive-in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with drive products offered shall be locally available at both the specifying and installation locations.

END OF SECTION 23 05 14

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Expansion joints.
 - 2. Pipe alignment guides.
 - 3. Pipe anchors.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.
 - 2. Section 23 21 13 - Hydronic Piping: Product and installation requirements for piping used in heating and cooling systems.

1.3 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
 - 1. Installation Temperature: 50 degrees Fahrenheit.
 - 2. Hot Water Heating System Temperature: 210 degrees Fahrenheit.
 - 3. Domestic Hot Water: 140 degrees Fahrenheit.
 - 4. Safety Factor: 30 percent.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered professional engineer.
- C. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

- D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.
- E. Manufacturer's Installation Instructions: Submit special procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.
- H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Amber / Booth
 2. Triplex
 3. Mason Industries
- B. Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 2. Maximum Compression: 1-3/4 inch.
 3. Maximum Extension: 1/4 inch.
 4. Joint: As specified for pipe joints.
 5. Size: Use pipe sized units
 6. Application: Steel piping three (3) inch and smaller.
- C. External Ring Controlled Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 2. Maximum Compression: 15/16 inch.
 3. Maximum Extension: 5/16 inch.
 4. Maximum Offset: 1/8 inch.
 5. Joint: Flanged
 6. Size: Use pipe sized units
 7. Accessories: Internal flow liner.
 8. Application: Steel piping three (3) inch and larger.
- D. Double Sphere, Flexible Compensators:
1. Body: Multi-layered Kevlar tire cord fabric reinforced with EPDM cover, liner and fabric frictioning with reinforcing ring.
 2. Working Pressure: 215 psi
 3. Maximum Temperature: 250 degrees Fahrenheit.
 4. Maximum Compression: 1-1/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 1-1/5 inch for 14 inch.
 5. Maximum Elongation: 3/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 5/8 inch for 14 inch.
 6. Maximum Offset: 3/8 inch through 6-inch pipe; 7/8-inch 8 inch through 12 inch; 1 inch for 14 inch.
 7. Maximum Angular Movement: 15 degrees.
 8. Joint: Steel flanges or ductile iron pipe flanges.
 9. Size: Use pipe sized units
 10. Accessories: Control rods.
 11. Application: Steel piping two (2) inch and larger.

2.2 ACCESSORIES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Amber / Booth
 2. Triplex

3. Mason Industries

- B. Pipe Alignment Guides: Two-piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1-inch-thick insulation, minimum 3-inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Work in accordance with ASME B31.9.
- B. Rigidly anchor pipe to building structure to prevent stresses and transfer of loading to connected equipment.
- C. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.
- D. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- E. Provide expansion loops as indicated on Drawings.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 23 05 16

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pressure gages.
 - 2. Pressure gage taps.
 - 3. Stem type thermometers.
 - 4. Dial thermometer.
 - 5. Thermometer supports.
 - 6. Test plugs.
 - 7. Bladder-type expansion tanks.
 - 8. Air vents.
 - 9. Combination Dir and Air Separators.
 - 10. Strainers.
 - 11. Flow controls / Balancing Valves.
 - 12. Relief valves.
- B. Related Sections:
 - 1. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.
- D. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable Victaulic style or series number.

- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and instrumentation.
- B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for piping specialties.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Weiss
 - 2. Weksler
 - 3. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Phosphor bronze.
 - 3. Dial Size: 4-1/2 diameter.
 - 4. Mid-Scale Accuracy: One (1) percent.
 - 5. Scale: Psi.

2.2 PRESSURE GAGE TAPS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Weiss
 - 2. Pete's Plug
- B. Needle Valve: Brass, 1/4-inch NPT for minimum 300 psi.
- C. Ball Valve: Brass 1/4-inch NPT for 250 psi.
- D. Pulsation Damper: Pressure snubber, brass with 1/4-inch NPT connections.
- E. Siphon: Brass, 1/4-inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Terice
 - 2. Weiss
- B. Thermometer: Rigid 90°F angle, blue colored, organic, mercury fill, Valox case, brass stem, ½ NPT brass thermowell, acrylic window, lens front, magnifying tube type, scale face of aluminum, white background with black graduations and markings
 - 1. Scale Size: 5-1/2" long.
 - 2. Molded Valox - V-shaped black case.
 - 3. Window: Double Strength Glass
 - 4. Stem: Brass, 1/2-inch NPT, and 2 inches long.
 - 5. Accuracy: ±2% of full scale ASME B40.4 Grade A.
 - 6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.4 DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Terice
 - 2. Weiss
- B. Thermometer: 300 stainless steel, hermetically sealed, bimetallic, silicone dampened on ranges to 300°F coil, adjustable angle, ½ NPT, double strength glass window, balanced, black finish pointer, dial face of aluminum, white background with black and blue graduations and markings.
 - 1. Dial Size: 5-inch diameter dial.
 - 2. Window: Double strength glass.
 - 3. Stem: 300 Stainless Steel, ¼" diameter NPT, 2-1/2" long.
 - 4. Length of Capillary: Minimum five (5) feet.
 - 5. Accuracy: ±1% of full scale ASME B40.4 Grade A.
 - 6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.
- B. Flange: Three (3) inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Pete's Plug
- B. 1/4-inch NPT or 1/2-inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
 - 1. Neoprene core for temperatures up to 200 degrees F.
- C. Provide extended stem to accommodate insulation.
- D. Test Kit:
 - 1. Carrying case, internally padded, and fitted containing:
 - a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
 - b. Two gage adapters with 1/8-inch probes.
 - c. Two 1-1/2-inch dial thermometers.

2.7 BLADDER-TYPE EXPANSION TANKS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Wheatly
 - 2. Bell and Gossett
 - 3. Wessels
 - 4. Armstrong
 - 5. Taco
 - 6. Thrush
- B. Tank: Welded steel, rated for maximum 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 1. Size: As indicated on Drawings.
- C. Bladder: Heavy duty butyl-FDA approved.
- D. Gage Glass Set: Brass compression stops, guard, and 3/4-inch red line glass, maximum 24 inches length, long enough to cover tank for two (2) inches above bottom to two (2) inches below top.

- E. Quick Connect Air Inlet:
 - 1. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.
- F. Automatic Cold-Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.
- G. Hot Water Heating System:
 - 1. Select expansion tank pressure relief valve at 20 psi maximum.
 - 2. Set pressure reduction valve at select 12 psi.
- H. Chilled Water System:
 - 1. Select expansion tank pressure relief valve at 25 psi maximum.
 - 2. Set pressure reduction valve at 12 psi.
- I. Do not insulate ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

2.8 AIR VENTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Armstrong
 - 2. ITT
 - 3. Sarco
- B. Manual Type: Short vertical sections of two (2) inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- C. Float Type:
 - 1. Brass, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Washer Type:
 - 1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

2.9 COMBINATION DIRT AND AIR SEPARATORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Bell and Gossett
 - 2. Armstrong
 - 3. Wessels
 - 4. Thrush

- B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.
- C. Dirt & Air Separator: Each separator must be designed with a blow-down valve, skim valve, and automatic air vent. The separator must also utilize in its design a stainless-steel coalescing medium to aid in the separation of air and dirt in the system entrained water. The separator must be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure.

2.10 STRAINERS (GROOVED) – APPLIES TO AIR-COOLED CHILLERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Victaulic
- B. Size two and a half inch (2-1/2") and Larger:
 - 1. Grooved iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.
- C. Couplings:
 - 1. Grooved mechanical Installation ready couplings manufactured of a two segment, ASTM A 536, Grade 65-45-12 ductile iron cast housing. Gaskets shall be pressure responsive synthetic rubber, and pre-injected with lubricant, grade EHP or to suit intended service, conforming to ASTM D-2000. Gaskets shall be rated for 250 degrees Fahrenheit and made by grooved manufacturer. Grooved couplings shall be provided "Installation-Ready"; pre-assembled and pushed onto grooved pipe end, joined by second grooved pipe end, and then bolts and nuts are tightened down (no loose parts during installation). Coupling bolts shall be zinc plated heat-treated carbon steel track head conforming to ASTM A-183.
 - a. Sizes up to 12": Rigid Type, Style 107; Flexible Type, Style 177.
 - b. Sizes 14" and larger: Rigid Type, Style W07; Flexible Type, Style W77.

2.11 FLOW CONTROLS / BALANCING VALVES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. TA / Victaulic
- B. 2" and smaller: 300 psi threaded or sweat ends, non-ferrous Ametal® brass copper alloy body, EPDM o-ring seals. 4 turn digital readout hand wheel for balancing, hidden memory feature with locking tamper-proof setting. Victaulic / Tour and Anderson Series balancing valve 787 (threaded) or Series 786 (Sweat). Suitable for operating temperatures to 250°F.
- C. 2-1/2" (DN65) and larger: 300 psi, grooved or flanged ends, ASTM A536 ductile iron body, all other metal parts of Ametal® brass copper alloy, EPDM O-ring seals. 8, 12 or 16 turn digital readout hand wheel for balancing, hidden memory feature with locking tamper-proof setting. Victaulic #788 (Flanged) or #789 (Grooved).
- D. Calibration: Factory set to control flow within three (3) percent of design flow over entire operating pressure.

- E. Accessories: In-line strainer on inlet and ball valve on outlet.
- F. Victaulic coil hookup packages for ½"- 2" shall include a Victaulic/TA valve style 78k; 787 or 786 connection and the following two components: 78U, 78Y. The Victaulic balancing valve shall be sized to flow, and all components shall be from one manufacturer, Victaulic. Victaulic 78U Union Port Fitting: 1/2" through 2" by Sizes: 400 psi maximum, Sweat/Soldered or FPT threaded x Union ends, DZR forged brass body with manual air vent port and pressure/temperature port, with EPDM seals. Union port fitting shall provide a simplified terminal hookup for installation at coil outlets. Suitable for operating temperatures up to 250°F. Victaulic series 78Y Strainer Ball Valve combination ½" through 2" up to 400psi Ametal copper alloy body consisting of a full port ball valve and strainer with pressure and temperature measuring ports. Ball valve shall be complete with Teflon packing, plated ball, blow-out proof stem, and steel handle with vinyl grip. Strainer shall be Y-pattern, with 20 mesh stainless steel screen and blowdown port.
- G. Victaulic coil hookup packages for 2½"- and larger shall include a Victaulic/TA valve style 788 or 789 and the following two components: 925 Air vent, 732 Y Strainer. The Victaulic balancing valve shall be sized to flow, and all components shall be from one manufacturer, Victaulic. Victaulic 925 Union Port Fitting: 2 1/2" through 4" by Sizes: 400 psi maximum CWP, Union port fitting shall provide a simplified terminal hookup for installation at coil outlets. Suitable for operating temperatures to 250°F. Victaulic series 732 Y Strainer 2 ½" through 4". Strainer shall be Y-pattern, with 20 mesh stainless steel screen and blowdown port. Victaulic series 300 master seal butterfly valve for isolation on supply side.
- H. All handles and pressure / sensor ports shall have extended stems to accommodate insulation.
 - 1. Accessories: Test Kit.
 - 2. Carrying case, internally padded, and fitted containing:
 - a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
 - b. Two gage adapters with 1/8-inch probes.
 - c. Two 1-1/2-inch dial thermometers.
- I. Coil Hook up Packages: Victaulic Series 799 including 78u air vent union fittings with extended probe sets with minimum 2" of clearance and 78y strainer/ball valves combination with extended handle and probe set with minimum 2" of clearance. Coordinate with manufacture to confirm insulation clearance. No flex hoses shall be used.

2.12 RELIEF VALVES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Bell and Gossett
 - 2. McDonnell-Miller
 - 3. Taco
- B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump, pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install thermometers in air duct systems on flanges.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
- G. Locate duct-mounted thermometers minimum ten (10) feet downstream of mixing-dampers, coils, or other devices causing air turbulence.
- H. Coil and conceal excess capillary on remote element instruments.
- I. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Locate test plugs adjacent to pressure gages and pressure gage taps and as indicated on Drawings.
- B. All Coil Kit valve assemblies shall come equipped with extended stems and extended handle to accommodate pipe insulation. Contractor shall coordinate pipe insulation thickness with coil kit manufacturer prior to ordering valves.
- C. Install manual air vents at system high points.
- D. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

- F. Provide drain and hose connection with valve on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- H. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- I. Support pump fittings with floor mounted pipe and flange supports.
- J. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- K. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Equipment relief valve capacity not to exceed rating of connected equipment.
- L. Pipe relief valve outlet to nearest floor drain.
- M. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- N. Insulate all volume tanks to match adjacent intake and discharge piping and jacketing requirements.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Globe valves.
 - 2. Ball valves.
 - 3. Plug valves.
 - 4. Butterfly valves.
 - 5. Swing check valves.
 - 6. Spring loaded check valves.
 - 7. Flanges, unions, and couplings.
 - 8. Vibration Isolation Suction and Discharge Pump Drops.

1.3 SUBMITTALS

- A. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.
- B. Welders Certificate: Include welder's certification of compliance with ASME Section IX.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install valves underground when bedding is wet or frozen.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for valves.

1.9 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING VALVES

A. Globe Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Milwaukee Valve
2. Two (2) inches and Smaller: Construction: Bronze body, bronze trim, union bonnet, rising stem and hand-wheel, inside screw, renewable plug disc and stainless-steel seat ring, solder or threaded ends.
3. Two (2) inches and Larger: Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

B. Ball Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Belimo
 - d. Milwaukee Valve
 - e. Jomar
2. Two (2) inches and Smaller: Bronze two-piece body, full port stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle with balancing stops, solder, or threaded ends with union.
3. Two (2) inches and Larger: Cast steel body, stainless steel ball and stem, Teflon seat and stuffing box seals, lever handle, or gear drive hand-wheel for sizes ten (10) inches and larger, flanged.
4. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive material. Also provide a protective sleeve to prevent damage to vapor seal when valve adjustment is made. Memory stops shall be adjustable after insulation is applied.

C. Plug Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
2. Two (2) inches and Smaller: Bronze body, bronze tapered plug, full port opening, non-lubricated, Teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
3. Two (2) inches and Larger: Cast iron body and plug, full port opening, pressure lubricated, Teflon packing, flanged ends. Furnish each plug valve with wrench with setscrew.

D. Butterfly Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
 - f. Jomar
2. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.
3. Disc: Aluminum bronze.
4. Operator: 10 position lever handle on sizes two and half (2 1/2) inches to four (4) inches.
5. Hand-wheel and gear drive on sizes larger than six (6) inches.

E. Butterfly Valves - Grooved: **Applies to HVAC pumps, air-cooled chillers and temporary chiller connections; refer to 2.2 of this spec section and Pump and Air-Cooled Chiller Detail.**

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Victaulic
2. Grooved end butterfly valves two (2) inches to twelve (12) inches shall have a ductile iron body, electroless nickel-plated ductile iron disc, blowout proof 416 stainless steel stem, disc shall be offset from stem centerline to provide full 360-degree seating, EPDM seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with memory stop feature equal to Victaulic Vic-300 MasterSeal.
3. Grooved end butterfly valves fourteen (14) inches to twenty-four (24) inches AGS grooved ends, polyphenylene sulfide (PPS) coated ductile iron body (ASTM A-

536, Grade 65-45-12), PPS coated ductile iron disc (ASTM A-536), and two-piece 17-4 PH S/S stem design. Seat and seal material to suit intended service. Reinforced PTFE bearings and gear operator. Bubble tight, dead-end, or bi-directional service. With memory stop for throttling, metering, or balancing service. Victaulic Vic®-300 AGS.

F. Spring Loaded Check Valves (Grooved): **Applies to Pumps and Air-Cooled Chillers; refer to 2.2 of this spec section and Pump and Air-Cooled Chiller Detail.**

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Victaulic
2. Two and a half (2-1/2) inches to twelve (12) inches: Ductile iron body, aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft, welded-in nickel or synthetic rubber seat with grooved ends equal to Victaulic Series 716.
3. Fourteen (14) inches to twenty-four (24) inches: Ductile iron body, stainless steel dual disc design, EPDM seat bonded to the valve body, 300 series stainless steel spring and shaft, AGS grooved ends equal to Victaulic Series W715.

G. Spring Loaded Check Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
2. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.
3. Two (2) and Smaller: Red bronze body, 301 stainless steel spring-actuated disc, EPDM o-ring, 300 series stainless steel stem and spring, in-line, lift-type check valve.

2.2 VIBRATION ISOLATION SUCTION & DISCHARGE HVAC PUMP DROPS – REQUIRED FOR ALL HVAC PUMPS

A. Manufacturer: Subject to compliance with plans and specification, provide the following:

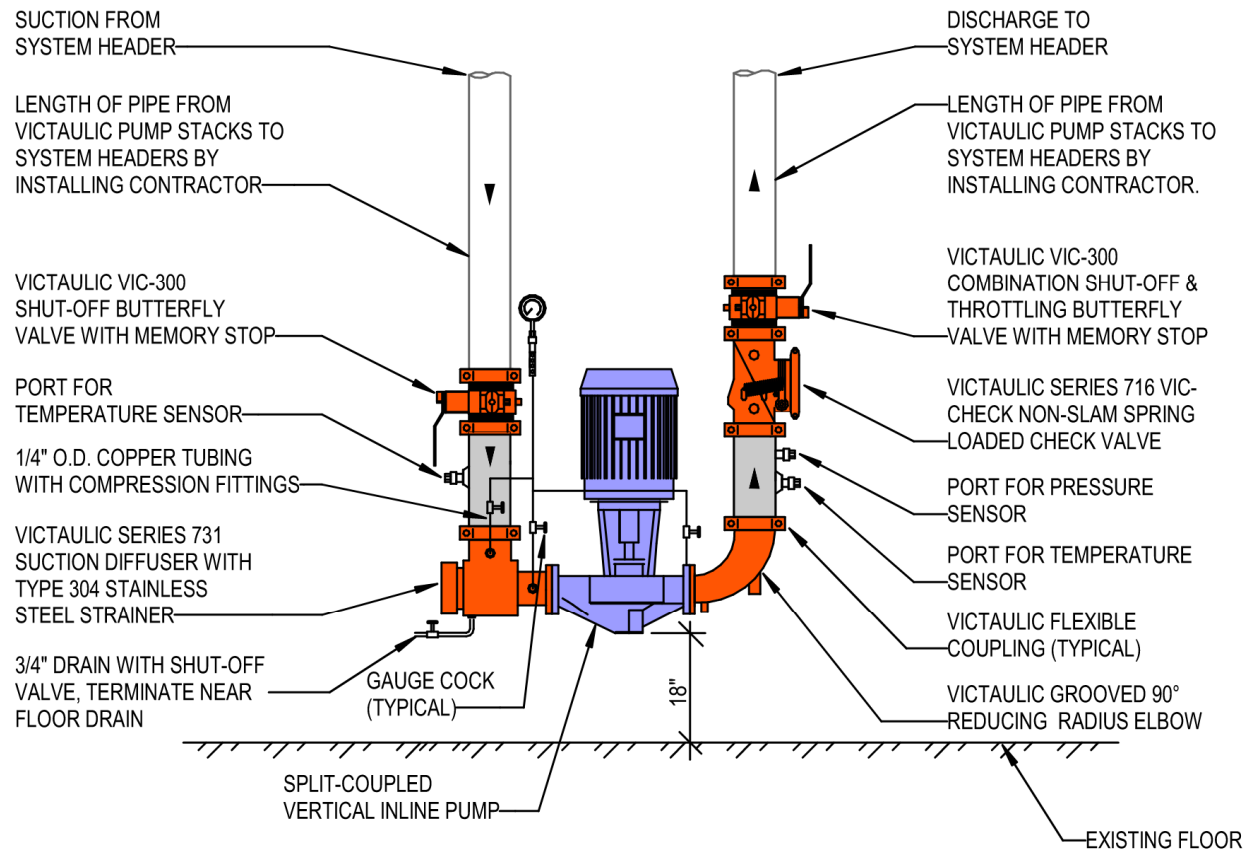
1. Victaulic.
 - a. Victaulic Suction Vibration Isolation Pump drop **model # 381**.
 - b. Victaulic Discharge Vibration Isolation Pump drop **model # 380**.

B. Suction Vibration Isolation Pump Drop **Model #381**:

1. Application:

- a. Suction vibration isolation pump drop connects the water flow intake to the pumps.
 - b. Provides vibration isolation, noise reduction, expansion, contraction, and deflection.
 - c. A minimum of (3) three Victaulic flexible couplings are to be utilized to aid in vibration isolation, noise reduction, expansion, contraction, and deflection as shown in detail; a separate pipe vibration isolator is not required.
2. Victaulic Grooved Shut-off Butterfly Valve:
- a. Grooved end butterfly valves two (2) inches to twelve (12) inches shall have a ductile iron body, electroless nickel-plated ductile iron disc, blowout proof 416 stainless steel stem, disc shall be offset from stem centerline to provide full 360-degree seating, EPDM seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with memory stop feature equal to Victaulic Vic-300 MasterSeal.
3. Victaulic Grooved Suction Diffuser:
- a. Angle pattern, with flanged outlet and grooved inlet connections.
 - b. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.
 - c. 20 mesh stainless steel, type 304 fine mesh startup pre-filter and 5/32" perforated type 304 stainless-steel permanent strainers.
 - d. Stainless-steel straightening guide vanes.
 - e. Drain plug, blow-down tapping in bottom, gage tapping on side.
 - f. Factory-fabricated adjustable foot support.
 - g. Provide bosses on either side for pressure measurement.
 - h. Permanent magnet located in flow stream removable for cleaning.
- C. Discharge Vibration Isolation Pump Drop **Model #380**:
1. Application:
- a. Discharge vibration isolation pump drop connects the pump to the interconnecting pipe / discharge header within the mechanical rooms.
 - b. Provides noise reduction, expansion, contraction, and deflection.
 - c. A minimum of (3) three Victaulic flexible couplings are to be utilized to aid in vibration isolation, noise reduction, expansion, contraction, and deflection as shown in detail; a separate pipe vibration isolator is not required.
2. Victaulic Grooved 90° Elbow Fitting:

- a. Two (2") - Twelve (12") DN50 – DN300.
 - b. Fitting Material: Ductile iron conforming to ASTM A536, Grade 65-45-12.
 - c. Maximum Working Pressure: 400 psi.
 - d. Coating: Orange.
3. Victaulic Grooved Non-Slam Spring Loaded Check Valve:
- a. Two and a half (2-1/2) inches to twelve (12) inches: Ductile iron body, aluminum bronze or elastomer encapsulated ductile iron disc, stainless steel spring and shaft, welded-in nickel, or synthetic rubber seat with grooved ends equal to Victaulic Series 716.
4. Victaulic Grooved Shut-off Butterfly Valve:
- a. Grooved end butterfly valves two (2) inches to twelve (12) inches shall have a ductile iron body, electroless nickel-plated ductile iron disc, blowout proof 416 stainless steel stem, disc shall be offset from stem centerline to provide full 360-degree seating, EPDM seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with memory stop feature equal to Victaulic Vic-300 MasterSeal.
 - b. Grooved end butterfly valves fourteen (14) inches to twenty-four (24) inches AGS grooved ends, polyphenylene sulfide (PPS) coated ductile iron body (ASTM A-536, Grade 65-45-12), PPS coated ductile iron disc (ASTM A-536), and two-piece 17-4 PH S/S stem design. Seat and seal material to suit intended service. Reinforced PTFE bearings and gear operator. Bubble tight, dead-end, or bi-directional service. With memory stop for throttling, metering, or balancing service. Victaulic Vic®-300 AGS.



CONTRACTOR SHALL DETERMINE FINAL LENGTH OF SUCTION AND DISCHARGE PIPING TO NEW PIPING HEADERS.

2.3 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe two (2) inches and Smaller:
 - 1. Ferrous Piping: 150 psig malleable iron, threaded.
 - 2. Copper Pipe: Bronze soldered or push-to-connect joints.
- B. Flanges for Pipe two (2) inches and Larger:
 - 1. Ferrous Piping: 150 psig forged steel, slip-on.
 - 2. Copper Piping: Bronze.
- C. Gaskets: 1/16-inch-thick preformed neoprene.
- D. Grooved Joint Flange Adapters two (2) inches and Larger:
 - 1. Ductile iron housing for use with grooved end pipe and fittings, flat face, for direct connection to flanges with ANSI Class 125 and 150 bolt hole patterns equal to Victaulic Style 741. For direct connection to flanges with ANSI Class 300 bolt hole pattern, use Victaulic Style 743.
- E. Grooved Pipe End Couplings:

1. Housing: Two-piece ductile iron housing conforming to ASTM A-536, Grade 65-45-12.
 2. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000. operating temperature range from -30 degrees Fahrenheit to 250 degrees Fahrenheit.
 3. Rigid type couplings shall have angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9 equal to Victaulic Style 107V.
 4. Flexible type couplings shall be used where vibration attenuation and stress relief are required, equal to Victaulic Style 177.
- F. Accessories: Stainless Steel bolts, nuts, and washers.
- G. Dielectric Connections:
1. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 2. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.
 3. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Use grooved mechanical couplings where approved by the engineer.
- D. Install butterfly or ball shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- E. Install calibrated-orifice, balancing valves at each branch connection to return main.
- F. Install globe or ball valves for throttling, bypass, or manual flow control services.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. Provide flow controls in water re-circulating systems.
- I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- J. Use 1 1/4" inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- K. Install valves in accessible locations to permit removal of bonnet.

- L. Install valve stems in vertical position. Valve stems installed in horizontal position shall be no less than 30 degrees from horizontal.
- M. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved joint couplings and valves shall be supplied by a single manufacturer. The gasket style and elastomeric material shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
 - 1. Install the grooved joint piping system in accordance with the latest manufacturer installation instructions. Pipe ends shall be clean and free from indentations and projections. Use manufacturer grooving tools with roll sets to groove the pipe. Follow manufacturer guidelines for tool selection and operation. Products shall not be installed with standard grooved end pipe or components. Installing products in combination with standard grooved end products could result in joint separation and/or leakage.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Equipment roof curbs and support rails.
 - 6. Sleeves.
 - 7. Mechanical link seals.
 - 8. Formed steel channel and angle.
 - 9. Equipment bases and supports.
 - 10. Portable roof pipe supports.
 - 11. Portable duct supports.
 - 12. Elevated modular service platform with stairs.
- B. Related Sections:
 - 1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.

- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Carpenter & Paterson Inc.
 - 2. Flex-Weld, Inc.
 - 3. Globe Pipe Hanger Products Inc.
 - 4. Michigan Hanger Co.
 - 5. B-Line Systems
 - 6. Carpenter & Patterson Inc.
 - 7. Anvil International
 - 8. Piping Technology & Products
 - 9. Grinnell
- B. Hydronic Piping:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.
 5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.
 6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.
 7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.
 8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.
 9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 10. Vertical Support: galvanized Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 14. Copper Pipe Support: Copper-plated, carbon steel ring.
 15. Hydronic Piping shall not have support brackets welded to hydronic piping.
- C. Roof Mounted Hydronic Piping:
1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

- A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

2.4 FLASHING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

- A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.
- B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12" high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.
- C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12" high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. The Pate Co.
 - b. Custom Curb, Inc.
 - c. Roof Products, Inc.
- E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.6 SLEEVES

- A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.7 MECHANICAL LINK SEALS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Thunderline Link-Seal / GPT.
 - 2. Innerlynx.

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.8 FORMED STEEL CHANNEL AND ANGLE

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.
- C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.
- D. Structural members to be loaded within manufacturers design limitations and published data.

2.9 EQUIPMENT BASES AND SUPPORTS

- A. In accordance with Division 3 – Concrete
- B. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:
 - 1. Hot Water Boilers: four (4) inches.
 - 2. Floor Mounted Pumps: four (4) inches.
 - 3. Floor Mounted Water Volume Tanks: four (4) inches.
 - 4. Air Handling Units: six (6) inches.
 - 5. Water Heaters: four (4) inches.
 - 6. Water Softeners: four (4) inches.
 - 7. Air Compressor: four (4) inches.
 - 8. Floor Mounted Expansion Tanks: four (4) inches.
 - 9. Floor Mounted chemical feeder tanks: four (4) inches.
 - 10. Floor Mounted Fans: four (4) inches.
 - 11. Chillers: four (4) inches.
 - 12. Condensing Units: four (4) inches.
 - 13. Heat Pump Units: six (6) inches.
 - 14. Dust Collectors: four (4) inches.
 - 15. Plasma cutters: four (4) inches.
- C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.10 PORTABLE ROOF PIPE SUPPORTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Advanced Support Products (ASP)
 2. PHP System Design
- B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be provided with height adjustable crossbar and clevis hangers. Product specifications:
1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
 2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
 3. Height: Adjustable.
 4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 5. Hardware: Corner brackets and leg brackets bolted with 1/2" x 2-1/2" bolt & 1/2" nut; frame bolted to support base with 1/2" x 2-1/2" bolts, 1/2" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
 6. Required accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.
- C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:
1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
 2. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 3. Hardware: 1/2" threaded rods (12" high); 1/2" nuts & washers, hot- dipped galvanized.
 4. Height: Adjustable.
 5. Required accessories: Strut clamps and protection pads.
 6. Hot dipped galvanized threaded rods, nuts, and washers.
- D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.
1. Material: Porous rubber.
 2. Weight: 2 lbs.
 3. Dimensions: 18" square X 1/2" thick.

2.11 PORTABLE DUCT SUPPORTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Advanced Support Products (ASP)
 2. PHP System Design
- B. Galvanized steel ductwork: Provide portable duct supports in 5'-0" maximum intervals for steel. Duct supports shall be with height adjustable crossbar and strut clamps. Product specifications:
1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
 2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.

3. Height: Adjustable.
 4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 5. Hardware: Corner brackets and leg brackets bolted with 1/2" x 2-1/2" bolts; & 1/2" nut; frame bolted to support base with 1/2" x 2-1/2" bolts, 1/2" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
 6. Required accessories: 1/2" threaded rod, strut clamps and protection pads.
- C. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.
1. Material: Porous rubber.
 2. Weight: 2 lbs.
 3. Dimensions: 18" square X 1/2" thick.

2.12 ELEVATED MODULAR SERVICE PLATFORM WITH STAIRS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Advanced Support Products (ASP).
 2. PHP System Design
- a. Provide elevated service platform around HVAC equipment. Service platform shall be constructed of minimum 12 Ga. hot dipped galvanized steel. Walking surface shall be 48 inches wide and constructed of minimum 12 Ga. hot dipped galvanized steel grip strut. Handrail and center bar shall be constructed of minimum 1.5-inch square tube. A full perimeter, 4-inch-tall toe kick shall be constructed of minimum 12 Ga. hot dipped galvanized steel.

Carbon Steel

Channel Type:	1-5/8" (41.3 mm) or 1-7/8" (47.6 mm) as required by loading
Form:	Roll-formed 3-sided tubular shape, perforated with 9/16" (14.3 mm) holes at 1-7/8" (47.6 mm) centers on three sides
Thickness:	12 gauge (2.7 mm)
Carbon Steel Finish:	Hot dip galvanized per ASTM A 123
Hardware :	Zinc Plated
Surface:	
Type:	Walkway Planking 18-ga. steel
Section Width X Height:	12" x 2.5"
Flange Options:	FM and MM
Surface Condition:	MG-traction grip
Carbon Steel Finish:	Hot dip galvanized per ASTM A 123
Type:	Bar grating type WB-4, Carbon Steel
	Section Width as required
Bar Grating Height:	1"
Surface Condition:	Serrated
Carbon Steel Finish:	Hot dip galvanized per ASTM A 123

- B. Elevated platform shall be a minimum of 4 feet above grade and include fully adjustable height bases. Refer to mechanical plans.

- C. Stair access shall match platform construction and dimensions and be aligned with the space for walking platform to be below service access doors.
- D. Platform shall ship in sections for field assembly and installation by installing mechanical subcontractor.
- E. **Coordinate with final approved Rooftop Unit submittal for accurate footprint and platform height prior to platform fabrication. Failure to do so will be at the cost of platform provider if platform is not snug and matches RTU footprint and curb height.**

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

- A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

- A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.

- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

- B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

- A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.
- E. Extend sleeves through walls two (2) inches each side.
- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

- A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.
- B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, and partition as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.

- d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- F. Non-Rated Surfaces:
- 1. Seal opening through non-fire rated wall and partition floor as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - 2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

- A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.
- B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- C. Access Doors:
 - 1. Plastic Surfaces: Milcor Style K.
 - 2. Ceramic Tile Surface: Milcor Style M.
 - 3. Drywall Surfaces: Milcor Style DW.
 - 4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

- A. Verify that roof surface is smooth and clean to extent needed to receive material.
- B. Clean surfaces to receive 17" circular bases removing any loose gravel and foreign matter before setting 17" circular bases.
- C. Provide protective pad conforming to the new or existing roof manufacturer's system under each 17" circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

- A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

- A. Minimum hanger rod size shall be ½".
- B. Maximum hanger rod spacing shall not exceed 10'-0" on center for pipe sizes 2" and above. Do not exceed 7'-0" hanger spacing for pipes sizes less than 2" diameter.
- C. For trapeze supports provide a minimum of (2) two ½" hanger rods at each end of trapeze for a total of (4) four for pipes 10" or larger.
- D. Beam clamps are not acceptable.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Vibration isolation for building mechanical systems.
- B. Related Sections:
 - 1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Mason Industries model numbers are listed for identification only.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Mason Industries
 - 2. Kinetics Noise Control
 - 3. Amber / Booth
 - 4. VMC

1.3 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35-inch deflection.
- E. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and anti-oxidant additives.
- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated

nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.
- I. Height savings brackets used with isolators having 2.5-inch deflection or greater shall be of the precompression type to limit exposed bolt length.
- J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
 - 1. Offices
Executive: 30
Conference rooms: 30
Private: 35
Open-plan areas: 35
Computer/business machine areas: 40
Public circulation: 40
 - 2. Schools
Lecture and classrooms: 30
Open-plan classrooms: 35
 - 3. Libraries: 25
 - 4. Theaters
Theater: 25
Stage house: 25
Trap room: 25
Orchestra pit: 25
Rehearsal rooms: 25
Teaching studios: 30
Practice rooms: 30
Ensemble rooms: 30

Shop: 45

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

1.5 QUALITY ASSURANCE

- A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum 1/4" thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.
- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow

for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.

- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate, and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each

support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- E. Install Work in accordance with ASME B31.9.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE						
EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE
AIR HANDLING UNITS (NOTE 2)						
FLOOR MOUNTED	SLF	0.75	-	SLF	0.75	-
TO 15 HP	SLF	1.5	-	SLF	0.75	-
20 HP & OVER						
SUSPENDED	30N	1	-	30N	1	-
UP TO 15 HP	PC30N	1.75	-	PC30N	1	-
20 HP & OVER						
HIGH PRESSURE FAN	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
SECTION (NOTE 1)	BI	2.5	RBMK	BI	1.5	RBMK
UP TO 30 HP	SLF/W			SLF/W		
40 HP & OVER	BI			BI		

<p>CENTRIFUGAL FANS</p> <p>CL. I & II UP TO 54-1/2" W.D.</p> <p>Up to 15 HP</p> <p>20-50 HP</p> <p>60 HP & OVER</p> <p>CL. I & II 60" W.D. & OVER/ALL</p> <p>CL. III FANS UP TO 15 HP</p> <p>20-50 HP</p> <p>60 HP & OVER</p>	<p>SLF</p> <p>SLF</p> <p>SLF</p> <p>SLF/W</p> <p>BI</p> <p>SLF/W</p> <p>BI</p> <p>SLF/W</p> <p>BI</p>	<p>0.75</p> <p>1.5</p> <p>2.5</p> <p>1.5</p> <p>2.5</p> <p>2.5</p>	<p>WF</p> <p>RBMK</p> <p>RBMK</p> <p>RBMK</p> <p>RBMK</p> <p>RBMK</p>	<p>SLF</p> <p>SLF</p> <p>SLF</p> <p>SLF/W</p> <p>BI</p> <p>SLF/W</p> <p>BI</p> <p>SLF/W</p> <p>BI</p>	<p>0.75</p> <p>0.75</p> <p>1.5</p> <p>0.75</p> <p>1.5</p> <p>1.5</p>	<p>WF</p> <p>WF</p> <p>WF</p> <p>RBMK</p> <p>RBMK</p> <p>RBMK</p>
<p>AXIAL-FLOW FANS (NOTE 1)</p> <p>FLOOR MTD.</p> <p>UP TO 15 HP</p> <p>20 HP & OVER</p> <p>SUSPENDED (NOTE 1)</p> <p>UP TO 15 HP</p> <p>20 HP & OVER</p>	<p>SLF</p> <p>SLF</p> <p>30N</p> <p>PC30N</p>	<p>0.75</p> <p>1.5</p> <p>1</p> <p>1.75</p>	<p>-</p> <p>-</p> <p>-</p> <p>WF</p>	<p>SLF</p> <p>SLF</p> <p>30N</p> <p>PC30N</p>	<p>0.75</p> <p>0.75</p> <p>1</p> <p>1.5</p>	<p>-</p> <p>-</p> <p>-</p> <p>-</p>
<p>VENT (UTILITY SETS)</p> <p>FLOOR MTD.</p> <p>SUSPENDED</p>	<p>SLF</p> <p>30N</p>	<p>0.75</p> <p>1</p>	<p>-</p> <p>-</p>	<p>SLF</p> <p>30N</p>	<p>0.75</p> <p>0.75</p>	<p>-</p> <p>-</p>
<p>CABINET FANS, FAN</p> <p>SECTIONS (NOTE 1)</p> <p>CL. I & II UP TO 54-1/2" W.D.</p> <p>Up to 15 HP</p> <p>20-50 HP</p> <p>SUSPENDED</p> <p>UP TO 15 HP</p> <p>20 HP & OVER</p>	<p>SLF</p> <p>SLF</p> <p>30N</p> <p>PC30N</p>	<p>0.75</p> <p>1.5</p> <p>1</p> <p>1.75</p>	<p>-</p> <p>-</p> <p>-</p> <p>-</p>	<p>SLF</p> <p>SLF</p> <p>30N</p> <p>30N</p>	<p>0.75</p> <p>0.75</p> <p>0.75</p> <p>1.75</p>	<p>-</p> <p>-</p> <p>-</p> <p>-</p>
<p>PUMPS</p> <p>FLOOR MTD. UP TO 60 HP</p> <p>FLOOR MTD. 75 HP AND</p> <p>LARGER</p> <p>SUSPENDED INLINE</p>	<p>SLF</p> <p>SLF</p> <p>PC30N</p>	<p>1.50</p> <p>2.50</p> <p>1.75</p>	<p>RBMK</p> <p>RBMK</p> <p>-</p>	<p>SLF</p> <p>SLF</p> <p>PC30N</p>	<p>0.75</p> <p>0.75</p> <p>1.75</p>	<p>RBMK</p> <p>RBMK</p> <p>-</p>
<p>REFRIGERATION UNITS</p> <p>RECIPROCATING</p> <p>COMPRSSORS</p> <p>RECIPROCATING COND.</p> <p>UNITS & CHILLERS</p> <p>HERMETIC</p> <p>CENTRIFUGALS</p> <p>OPEN CENTRIFUGALS</p> <p>ABSORPTION MACHINES</p>	<p>SLF</p> <p>SLR/IC</p> <p>S</p> <p>SLR</p> <p>SLF</p> <p>SLR/IC</p> <p>S</p>	<p>1.5</p> <p>1.5</p> <p>1.5</p> <p>1.5</p> <p>0.75</p>	<p>RBMK</p> <p>-</p> <p>-</p> <p>RBMK</p> <p>-</p>	<p>SLF</p> <p>SLF</p> <p>WSW</p> <p>WSW</p> <p>WSW</p>	<p>0.75</p> <p>0.75</p> <p>0.15</p> <p>0.15</p> <p>0.15</p>	<p>RBMK</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p>
<p>AIR COMPRESSORS</p> <p>TANK TYPE (HORIZONTAL</p> <p>TANK)</p>	<p>SLF</p> <p>SLF</p>	<p>1.5</p> <p>1.5</p>	<p>-</p> <p>-</p>	<p>SLF</p> <p>SLF</p>	<p>0.75</p> <p>0.75</p>	<p>-</p> <p>-</p>

TANK TYPE (VERTICAL TANK)						
COOLING TOWERS & CLOSED-CIRCUIT COOLERS UP TO 500 TONS OVER 500 TONS	SLR	0.75	(1)	WSW	0.15	-
	SLR	2.5	(1)	WSW	0.15	-
AIR COOLED CONDENSERS UP TO 50 TONS OVER 50 TONS	SLR	0.75	(1)	WSW	0.15	-
	SLR	1.5	(1)	WSW	0.15	-
ROOFTOP AIR CONDITIONING UNITS REQUIRING WEATHER SEAL UP TO 5000 CFM (12 TON) OVER 5000 CFM (12 TON) OTHER TYPES UP TO 25 TONS OVER 25 TONS	SLF	0.75	RSC/C	-	-	-
	SLR	1.5	MAB	-	-	-
	SLR	1.5	RSC/C	-	-	-
	SLR	1.5	MAB	-	-	-
	SLR	1.5	(1)	-	-	-
	SLR	1.5	(1)	-	-	-
BOILER (PACKAGE TYPE) ALL SIZES	SLR	0.75		WSW	0.15	-
ENGINE DRIVEN GENERATORS UP TO 60 HP 75 HO & OVER	SLR	1.5	RBMK	SLR	0.75	-
	SLR	2.5	RBMK	SLR	0.75	-

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.
2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.
 - 8. Pipe painting (if required)
- B. Related Sections:
 - 1. Section 09 91 00 - Painting and Staining.
- C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 2. District Standards for identification and color scheme.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ANSI / OSHA Pipe Marking Specifications.
- C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
 - 5. Marking Services, INC. (MSI).
 - 6. Brimar.
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
 - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.
- B. Metal Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

2.3 STENCILS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
 6. Brimar.
- B. Stencils: With clean cut symbols and letters of following size:
1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
 2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.
 3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 4. Ductwork and Equipment: 1-3/4 inches high letters.

- C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

- 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
- 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

B. Plastic Tape Pipe Markers:

- 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
- 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

C. Plastic Underground Pipe Markers:

- 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - f. Brimar.
- 2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- 1. Craftmark Identification Systems.
- 2. Safety Sign Co.

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3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Steel with 3/4-inch diameter color-coded head.

2.6 LABELS

A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Craftmark Identification Systems.
2. Safety Sign Co.
3. Seton Identification Products.
4. Almetek Industries.
5. Marking Services, INC. (MSI).
6. Brimar.

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- a. Craftmark Identification Systems.
- b. Safety Sign Co.
- c. Seton Identification Products.
- d. Almetek Industries.
- e. Marking Services, INC. (MSI).
- f. Brimar.

2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

B. Valve Lockout Devices:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

- a. Craftmark Identification Systems.
- b. Safety Sign Co.
- c. Seton Identification Products.
- d. Almetek Industries.
- e. Marking Services, INC. (MSI).
- f. Brimar.

2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.
- F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.
- G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.
- H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify insulated piping, concealed, or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.
- N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULE

- A.** Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply
Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply Condenser Water Return

B. PIPE PAINTING:

1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.
2. The entire fire protection piping system shall be painted red.
3. All outdoor un-insulated piping shall be painted with primer as a minimum.
4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

C. PAINTING SCHEDULE

SYSTEM	COLOR
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water supply and Return	Reddish Orange

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of Hydronic piping systems
 - 3. Testing, adjusting, and balancing of refrigerating systems.
 - 4. Measurement of final operating condition of HVAC systems.
 - 5. Sound measurement of equipment operating conditions.
 - 6. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Sequences of operation for HVAC equipment as scheduled on Drawings.
- C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.
- D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.
- E. TAB Contractors:
 - 1. Engineered Air Balance
 - 2. Precision Air

1.3 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- C. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- D. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
- E. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
- F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.
 - 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.
 - 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.
 - a. General Information and Summary
 - b. Air Systems
 - c. Refrigerant Systems
 - d. Temperature Control Systems
 - e. Special Systems.
 - 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project.

Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.5 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
 - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
 - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
 - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. AABC: "National Standards for Total System Balance."
 - 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final

coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed, and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.

14. Proper strainer baskets are clean and in place or in normal position.
 15. Service and balancing valves are open.
 16. Re-sheave
- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
 2. Air Outlets and Inlets: +/- 5%
 3. Heating-Water Flow Rate: +/- 5%
 4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
 2. Verify sufficient inlet static pressure before making volume adjustments.
 3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.
- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 - 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Balance variable-air-volume systems the same as described for constant-volume air systems.

2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated pre-settings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove

proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

- A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.22 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:

1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in deg F (deg C).
 - k. Leaving-water temperature in deg F (deg C).
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig (kPa).
 - n. Refrigerant suction temperature in deg F (deg C).
 - o. Inlet steam pressure in psig (kPa).
- G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).

- b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.

- d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).

- h. Final total pressure in feet of head or psig (kPa).
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

N. Vibration Test:

1. Location of points:

- a. Fan bearing, drive end
- b. Fan bearing, opposite end
- c. Motor bearing, center (when applicable)
- d. Motor bearing, drive end
- e. Motor bearing, opposite end
- f. Casing (bottom or top)
- g. Casing (side)
- h. Duct after flexible connection (discharge)
- i. Duct after flexible connection (suction)

2. Test readings:

- a. Horizontal, velocity and displacement
- b. Vertical, velocity and displacement
- c. Axial, velocity and displacement
- d. Normally acceptable readings, velocity and acceleration
- e. Unusual conditions at time of test
- f. Vibration source (when non-complying)

O. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section Includes: Insulation systems for sheet metal duct conveying cold, hot, and grease laden air.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated, and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.
- B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:
- C.
 - 1. NFPA 90A.
 - 2. NFPA 90B.
 - 3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
 - 4. ASTM C1136: 150 degrees F.
 - 5. ASTM C1290.
 - 6. UL 181 for Class I Air Duct.
 - 7. NAIMA AHS-152T.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.

- B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.
- C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

1.6 DELIVERY, STORAGE & HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – MUST BE MANUFACTURED AND BRANDED BY ONE OF THE FOLLOWING:

- A. Fiber Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Owens Corning
 - 2. Johns Manville
 - 3. CertainTeed
 - 4. Knauf brand Insulation
- B. Mastics and Adhesive: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
- C. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
 - 1. Perma Glass
 - 2. Alpha Glass
 - 3. Childers
 - 4. Vimasco
- D. Fire Wrap Insulation: Subject to compliance with plans and specification, provide one of

the following:

1. 3M Fire Barrier Duct Wrap
2. Vesuvius Pyroscat Duct Wrap
3. Unifrax Corporation

2.2 DUCT WRAP

- A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.
- B. Density: 0.75 pounds per cubic foot.
- C. Installed minimum R value: 8.3.
- D. Nominal Thickness: 3.0 inches.
- E. Installed Thickness: 2-1/4 inches.
- F. Installed Thermal Conductivity (compressed): $k = 0.27$
- G. Operating Temperature (ASTM C411): up to 250° Fahrenheit.
- H. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.
- J. Testing Method 1338: Fungi Resistance Comply with requirements.
- K. ASTM 665 Mineral Fiber Thermal Insulation: Comply with requirements.
- L. Surface Burning Characteristics (ASTM E84): Flame spread 25, smoke developed 50.

2.3 ACOUSTICAL FLEXIBLE DUCT LINER:

- A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.
- A. Density: 1.5 pounds per cubic foot.
- B. Installed minimum R value: 6.3.
- C. Thickness: 1-1/2 inches.
- D. Thermal Conductivity k , (ASTM C518): 0.24
- E. Acoustic Performance: Sound absorption coefficients at octave band center frequencies (Hz)

Freq. (Hz)	<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>	<u>NRC</u>
TL (dB)	0.19	0.55	0.84	1.0	1.0	.98	.85
- F. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.
- G. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.

- H. Maximum Air Velocity (UL 181 Erosion test ASTM C1071): 6,000 fpm.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120°F, 95% RH.
- J. Fungi Resistance (ASTM C1338 & G21): Comply with requirements.
- K. Bacteria Resistance (ASTM G22): Comply with requirements.
- L. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.
- M. Surface Burning Characteristics (ASTM E84, UL 723): Flame spread 25, smoke developed 50.

2.4 GREASE EXHAUST DUCT

- A. 1-1/2-inch-thick refractory ceramic blanket or calcia, magnesia and silica with aluminum foil, fiberglass-reinforced scrim encapsulation.
- B. Product to be UL Listed as a two (2) hour duct enclosure.
- C. Product shall be tested in accordance with the following:
 - 1. ASTM G 411
 - 2. ASTM C 51
 - 3. ASTM E 84
 - 4. ASTM E 119
 - 5. ASTM E 136
 - 6. ASTM E 814
 - 7. UL 1978 Sections 12 and B

2.5 ACCESSORIES

- A. Pressure-Sensitivity Aluminum Foil Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part I, identified by name, date of manufacture, product name/number and UL 181A.
 - 2. Size: At least 2-1/2 inches wide.
- B. Heat-Activated Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.
 - 2. Size: At least three (3) inches wide.
- C. Mastic and Glass Fabric System:
 - a. Material Standard: Listed and labeled under UL 181A, Part III.
 - b. Size: At least three (3) inches wide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the duct insulation manufacturer.

3.2 INSTALLATION

A. ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:

1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.
2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.
3. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:
 - a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: 12 inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 18 inches on center.
 - b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: six (6) inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 16 inches on center.
4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.
5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.
6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.
7. If the specification requires use of multiple insulation layers, take the following additional steps:
 - a. Affix bottom layer of duct liner in normal manner.
 - b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.
 - c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.
 - d. Use mechanical fasteners of the proper length for the double layer.

8. Application: Provide duct liner as follows:
 - a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
 - b. Provide duct liner in all return air boots and transfer ducts.
 - c. Provide duct liner in the first 20 feet of supply and return duct from roof mounted air handling units / roof top units.

B. THERMAL INSULATION WRAP ON DUCT AND FITTINGS:

1. Before applying duct wrap, air ducts must be clean, dry, and tightly sealed at all joints and seams.
2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.
3. To ensure installed thermal performance, duct wrap insulation shall be cut to "stretch-out" dimensions as shown in tables in manufacturer's literature.
4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.
5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2-inch minimum steel outward clinching staples.
6. Seal seams and joints with glass fabric and mastic. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.
7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18-inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.
8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.
9. Application: Provide duct wrap as follows:
 - a. All supply duct
 - b. All outside air supply and intake duct
 - c. All return air duct
 - d. All return air plenums on air units
 - e. All intake plenums on outside air handling units
 - f. All ductwork routed in un-conditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

C. GREASE EXHAUST DUCT AND FITTINGS:

1. Provide one (1) or two (2) layers of Ductwrap to create a 2-hour rated duct enclosure. Each layer shall be lapped a minimum of three (3) inches. Inner layer shall be held in place with one (1) inch wide filament tape, spaced 1-1/2 inch from edges and midway at 10-1-2 centers. The outer layer shall be offset by 10-1/2 inches of inner layer, and one (1) inch wide filament tape shall be used in same manner as inner layer. 1/2-inch x 0.015-inch carbon steel banding strips on shall be installed same dimensions as tape to secure both layers on duct. All horizontal and vertical support hangers shall be wrapped with 1-layer of fire rated duct wrap and be secured with stainless steel ties or 1/2-inch hose clamps.
2. Access Door Installation: Four galvanized steel threaded rods, 1/4-inch diameter by 5 inches long are to be welded to the duct at the corners of the door opening. Four steel tubes, each 3 inches long, are placed over the rods to act as protection for the duct wrap when fastening the door. Four insulation pins are to be welded to the door panel for installation of the blanket. One layer of duct wrap is cut approximately the same size as the access panel and impaled over the insulation pins on the panel. It is essential that this layer fit tightly against the wrap surrounding the access door opening with no through openings. A second layer of duct wrap is cut to overlap the first layer by a minimum of one (1) inch. The second layer is impaled over the pins and both layers are locked in place with galvanized speed clips. Pins that extend beyond the outer layer of duct wrap shall be turned down to avoid sharp points. The insulated door panel is placed over the threaded rods and held in place with washers and wing nuts. Provide an access door at each change in duct direction and a minimum of every 10 feet on straight duct.
3. Filament tape can be used to temporarily hold the blanket in place until the banding is applied. The steel banding is applied around the duct 1-1/2 inch from edge of the blanket, and maximum 10-1/2-inch centers. The banding is placed around the material and tightened so as to sufficiently hold the duct wrap in place against the duct, compressing the foil but not cutting the foil.
4. Additional Pinning to Prevent Sagging of Wrap: For ducts 24 inches and larger in width, additional pins are needed to support the blanket on the bottom horizontal surface and on the outside face of a vertical duct run. Space pins a maximum of 10-1/2 inches apart in the direction of the blanket width, and a maximum of 12 inches apart in the direction of the blanket length.
5. Provide 12 ga copper-coated steel insulation pins with 1.5-inch square or round cup-head pins. Insulation pins are to be welded to ducts.
6. Duct Support Systems: Provide one layer of insulation to cover support components. Maintain 3-inch overlap.
7. Application:
 - a. Provide 2-hour enclosure on grease exhaust duct. Enclosure shall extend from kitchen hood to underside of roof deck.

D. INTERIOR EXPOSED DUCT

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 1-1/2", 1.5 pcf (installed R-Value of 6.0) on interior

exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.

2. Round duct to be galvanized spiral lockseam type.
3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.
4. Application: Provide double wall duct as follows:
 - a. Gymnasiums
 - b. Natatoriums
 - c. Return air plenums with ducted connection to return grilles
 - d. Ducted connections to return air grilles
 - e. Any area where ductwork is exposed

3.3 FIELD QUALITY CONTROL

- A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.
- B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

3.4 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 INSULATION SCHEDULE

- A. Supply and return ducts routed indoors (Ambient temperature \leq 85 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).
- B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not limited to: un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms and crawl spaces. (Ambient temperature \leq 95 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).
- C. Supply, return and exhaust ducts routed outdoors or in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).
- D. R-values represent installed values.
- E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

END OF SECTION 23 07 13

SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Chilled Water Components
 - 2. Heating Hot Water Components

1.2 SYSTEM DESCRIPTION

- A. Provide equipment insulation systems that have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide equipment insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
 - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
 - 2. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.
- B. Condensation on any insulated system is not acceptable. Replace insulation damaged by condensation.
- C. Insulation to provide minimum R-Value in accordance with International Energy Conservation Code with Houston Amendment.

- D. Certifications: Manufacturer certification that products supplied meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Johns Manville
 - 2. Owens-Corning
 - 3. Knauf
 - 4. Certainteed
- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Pittsburg Corning
 - 2. Cell-U-Form
- C. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Vimasco
 - 5. RPR Products Inc.
- D. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco

2.2 EQUIPMENT INSULATION

A. Glass Fiber Insulation Boards:

1. Thickness: Same thickness as connected piping.
2. Equipment Operating Temperature Limit (ASTM C411): Up to 450 degrees Fahrenheit.
3. Insulation Jacket Temperature Limit (ASTM C1136): -20 - 150 degrees Fahrenheit.
4. Vapor Retarder: ASJ vapor retarder facing.
5. Jacket Permeance (ASTM E96): 0.02 perm.
6. Jacket Puncture Resistance (ASTM D781): ASJ: 50 units.
7. Water Vapor Sorption (ASTM C1104): <2percent by weight at 120 degrees Fahrenheit.
8. Density: Same as adjoining pipe insulation.
9. Composition Surface Burning Characteristics (UL 723, ASTM E84): Flamespread 25, smoke developed 50.

B. Equipment and Tank Insulation:

1. Description: Flexible pipe and tank insulation made of semi-rigid fibrous glass board material with a laminated Kraft-aluminum foil ASJ facing.
2. Operating Temperature (ASTM C411): 0 - 650 degrees Fahrenheit.
3. Length: 36 inches.
4. Size: 1-1/2 inches.
5. Material Standard: Comply with ASTM C1393, Type II.
6. Material Standard: Comply with ASTM C795.
7. Material Standard: Comply with ASTM C1136, Type II.
8. Material Standard: Comply with NRC Guide 1.36.
9. Jacket Temperature Limitation (ASTM C1136): -20 - 50 degrees Fahrenheit.
10. Jacket Permeance (ASTM E961): 0.02 perm.
11. Puncture Resistance (ASTM D781): 50 units.
12. Compressive Strength at 10 % Deformation (ASTM C165): 125 psf.

2.3 CELLULAR GLASS INSULATION

- A. Rigid factory fabricated closed-cell equipment insulation:
 - 1. Thermal conductivity "k" of btuh-in / hr-sq.ft. degree F at 75-degree mean temperature.
 - 2. Density shall be an average of 8 lb./cu.ft.
 - 3. Compressive strength of 100 psi.

2.4 ALUMINUM JACKET

- A. Jacket for equipment and tanks shall be 0.16-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering. Fitting covers shall be manufactured to ASTM C-450 standards.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breeching, or stacks while hot.
- E. Apply insulation using staggered joint method for both single- and double-layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least two (2) inches. Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

- J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by manufacturer.

3.2 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the equipment insulation manufacturer.

3.3 EXAMINATION

- A. Site Verification of Conditions:
- B. Verify that site conditions are acceptable for installation of equipment insulation.
- C. Do not proceed with installation of equipment insulation until unacceptable conditions are corrected.

3.4 INDOOR CHILLED WATER PUMPS

- A. Shall be insulated with rigid insulation board, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide x .020 galvanized bands spaced on nine (9) inch centers. Bands shall be pulled snug over sheets of insulation board. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. All voids on the interior of box shall be filled with glass fiber blanket insulation. Exterior shall be finished with a trowel coat of vapor barrier mastic, a layer of one (1) inch mesh galvanized wire, and a coat of cement. Final finish shall be an eight-ounce canvas jacket, pasted and sealed in place.
- B. Pipe insulation shall be extended over all cold parts of chilled water pumps not directly over drainage basin of pump base.

3.5 OUTDOOR CHILLED WATER PUMPS

- A. Shall be insulated with cellular glass insulation, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide aluminum bands spaced on nine (9) inch centers. Bands shall be pulled snug over insulation. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. Provide aluminum jacket over insulation.

3.6 ALUMINUM JACKET

- A. Install insulating materials per manufacturer's recommendations.
- B. Install aluminum jacketing per manufacturer's recommendations.
- C. Apply aluminum jacketing by lapping, sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.
- D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.
- E. Lap joints against weather so that water will run off lower edge.

- F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.
- G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.
- H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.
- I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.
- J. Equipment exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

3.7 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATED WITH FIBERGLASS

- A. Location: Indoor, conditioned spaces
- B. Support Inserts: At each support point, install a hard section of cellular glass on lower 180 degrees of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Seal and finish to match the adjoining insulation. Provide formed 16 ga. galvanized sheet-metal saddles.
- C. Installation: All equipment must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide three (3) inch butt strips at each joint between sections and seal with adhesive.

3.8 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATE WITH CELLULAR GLASS

- A. Location: Outdoor, un-conditioned spaces and ventilated spaces
- B. The insulation shall be applied to equipment with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
- C. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
- D. Metal jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
- E. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

3.9 INSULATION SCHEDULE

- A. Chilled water components located within condition spaces.
 - 1. Insulation thickness: Match adjoining piping thickness.
- B. Chilled water components located in un-conditioned or ventilated spaces and outdoors

1. Insulation thickness: Match adjoining piping thickness.

3.10 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 16

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Pipe Insulation

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
 - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- C. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
 - 1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - b. Detail attachment and covering of heat tracing inside insulation.
 - c. Detail insulation application at pipe expansion joints for each type of insulation.
 - d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - e. Detail removable insulation at piping specialties.
 - f. Detail application of field-applied jackets.
 - g. Detail application at linkages of control devices.

1.5 QUALITY ASSURANCE

- A. Installation Qualifications: Utilize an installer having demonstrated (5) five years experience on projects of similar size and complexity.
- B. Condensation on any insulated piping system is not acceptable. Replace insulation damaged by condensation at no additional cost.
- C. All materials shall conform to Composite Surface Burning Characteristics (UL 723, ASTM E84):
 - 1. Flamespread: 25
 - 2. Smoke developed: 50
- D. All materials shall have U.L. label.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver insulation materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Johns Manville
 - 2. Owens Corning
 - 3. Certainteed

- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Pittsburg Corning
 - 2. Cell-U-Foam
- C. Phenolic Foam Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Resolco
 - 2. Koolphen® K
- D. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Pabco
 - 3. RPR
- E. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Vimasco
- F. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco

2.2 FIBERGLASS PIPE INSULATION

- A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
 - 1. Thermal conductivity "k" of 0.23 of Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
 - 2. Maximum jacket permeance shall be 0.02.

2.3 CELLULAR GLASS INSULATION

- A. Rigid factory fabricated closed-cell pipe insulation:
 - 1. Thermal conductivity "k" of 0.32 Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
 - 2. Density shall be an average of 8 lb/cu.ft.
 - 3. Maximum jacket permeance shall be 0.02.
 - 4. Compressive strength of 100 psi.

2.4 PHENOLIC FOAM INSULATION

- A. Rigid factory molded phenolic foam insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
 - 1. Thermal conductivity "k" of 0.15 btu-in / hr-sq.ft. °F at 75°-degree mean temperature.
 - 2. Maximum jacket permeance shall be 0.02.
 - 3. Compressive strength of 100 psi

2.5 ALUMINUM JACKET

- A. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

PART 3 -EXECUTION

3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer's recommendations.

3.2 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

- A. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- B. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

- D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- E. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- F. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- G. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- H. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- I. Apply multiple layers of insulation with longitudinal and end seams staggered.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- L. Keep insulation materials dry during application and finishing.
- M. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- N. Apply insulation with the least number of joints practical.
- O. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- Q. Apply insulation continuously through hangers and around anchor attachments.
- R. For insulation application where vapor retarder is indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- T. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

- U. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- V. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- W. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder
 - 4. Vapor-Retarder Mastics: Where vapor retarder is indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings, at penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
 - 5. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - a. Seal penetrations with vapor-retarder mastic
 - b. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - c. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
 - d. Seal metal jacket to roof flashing with vapor-retarder mastic.
 - 6. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
 - 7. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
 - 8. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Fire stopping and fire-resistive joint sealers are specified in Division 7.
 - 9. Floor Penetrations: Apply insulation continuously through floor assembly.
 - a. For insulation with vapor retarder, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

- X. Insulation Installation of Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
 3. For insulation with factory-applied jackets without integral vapor retarder, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- Y. Insulation Installation on Pipe Flanges:
1. Apply preformed cellular-glass pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cellular-glass block insulation.
 4. Install jacket material with manufacturers recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- Z. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of molded cellular-glass insulation and match thickness to that of adjoining pipe. Fittings and fabricated segments shall be securely held in place with ½ inch x 0.20-inch type 3105 aluminum bands.
 - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 - c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.
- AA. Insulation Installation on Valves:
1. Install preformed two-piece factory molded cellular-glass insulation to valve body, match adjoining pipe insulation thickness. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application.
 - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

- c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

BB. PVC Cover:

1. Provide factory molded covers for all fittings, elbows and flanges.

3.4 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 - a. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - b. Embed 10 x 10 fiberglass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.
 - c. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Apply foil and paper jackets where indicated.
 - a. Draw jacket material smooth and tight.
 - b. Apply lap or joint strips with the same material as jacket.
 - c. Secure jacket to insulation with manufacturer's recommended adhesive.
 - d. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints. Where vapor retarder is indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder mastic to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
 - e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

3.5 CHILLED WATER, HOT WATER, CONDENSATE DRAIN AND MISCELLANEOUS PIPING SYSTEMS

- A. Location: Indoor, conditioned spaces - return air plenums, air handling unit rooms
- B. Insulation Type:
 1. Heating Water and Condensate Piping: **Fiberglass**
 2. Chilled Water Piping: **Phenolic Foam**
- C. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation. Cellular glass length shall overhang a minimum of 2" on both sides of the saddle. Refer to 3.5, E for saddle length requirements.
- D. Provide formed 16 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside

hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends with aluminum banding with a thickness of 0.20, $\frac{3}{4}$ " width and joined with $\frac{3}{4}$ " aluminum wing seals.

E. Provide formed 16 ga. galvanized sheet-metal saddles as follows:

3. Insert and saddle lengths:

- a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
- b. 3 inch through 6-inch pipe - 12 inches Long
- c. 8 inch through 10-inch pipe - 16 inch Long
- d. 12 inches and larger pipe - 22 inches Long

F. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide 3-inch butt strips at each joint between sections and seal with adhesive.

G. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.6 CHILLED WATER, HOT WATER, CONDENSATION DRAIN AND MISCELLANEOUS PIPING SYSTEMS

A. Location: Outdoor, un-conditioned spaces (non-return air plenums) and ventilated spaces. Shall include but not limited to: boiler rooms, non-return air plenum mechanical rooms, chiller rooms, and pump rooms.

B. Insulation Type:

1. Condensate Piping: **Fiberglass**
2. Chilled Water and Heating Water Piping: **Phenolic Foam**

C. Cellular Glass Installation:

1. The insulation shall be applied to piping with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
2. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
3. Aluminum jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
4. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

D. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation.

E. Provide formed 14 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends

with aluminum banding with a thickness of 0.20, $\frac{3}{4}$ " width and joined with $\frac{3}{4}$ " aluminum wing seals.

F. Provide formed 14 ga. galvanized sheet-metal saddles as follows:

1. Insert and saddle lengths:

- a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
- b. 3 inch through 6-inch pipe - 12 inches Long
- c. 8 inch through 10-inch pipe - 16 inch Long
- d. 12 inches and larger pipe - 22 inches Long

G. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive and vapor retarder mastic. Provide 3-inch butt strips at each joint between sections and seal with adhesive.

H. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.7 ALUMINUM JACKET

A. Install insulating materials per manufacturer's recommendations.

B. Install aluminum jacketing per manufacturer's recommendations.

C. Apply aluminum jacketing by lapping and sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.

D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.

E. Lap joints against weather so that water will run off lower edge.

F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.

G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.

H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.

I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.

J. Pipe exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

K. All exterior pipes shall have specified aluminum jacket for protection.

3.8 PROTECTION

A. Replace damaged aluminum jacketing and insulation, including insulation with vapor barrier damage and moisture-saturated insulation.

- B. The insulation contractor shall advise the general and / or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.9 INSULATION SCHEDULE

- A. Chilled water piping located within condition spaces.
 - 1. Insulation thickness **(Phenolic Foam)**:
 - a. 1-1/2" thick insulation for: 1/2" through 2" pipe
 - b. 2" thick insulation for: 2-1/2" and larger pipe
- B. Chilled water and hot water piping located in un-conditioned or un-ventilated spaces and outdoors.
 - 1. Insulation thickness **(Phenolic Foam)**:
 - a. 1-1/2" thick insulation for: 1/2" through 2" pipe
 - b. 2" thick insulation for: 2-1/2" and larger pipe
- C. Hot water piping located within conditioned spaces
 - 1. Insulation thickness: **(Fiberglass)**:
 - a. 1-1/2" thick insulation for: 1/2" through 1-1/2" pipe
 - b. 2" thick insulation for: 2" and larger pipe
- D. Cold Condensate Drain Lines
 - 1. Insulation thickness: **(Fiberglass)**:
 - a. 1" thick insulation for all pipe sizes and locations

END OF SECTION 23 07 19

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Section 019114 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 UNIT PRICES

- A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.

- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.8 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least [10] days in advance of testing and balancing Work and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Subcontractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R **Subcontractor** shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test

section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.
 3. Minimum flushing water velocity.
 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of hot-water and solar systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.
- H. Refer to plans and specifications for HVAC system type.

END OF SECTION 23 08 00

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 09 23 - DIRECT DIGITAL CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Heating and cooling piping:
 - 1. Control valves
 - 2. Flow meters
 - 3. Flow switches
 - 4. Press and temp sensor wells & sockets
 - 5. Temp sensor wells and sockets
- B. Duct accessories:
 - 1. Airflow stations
 - 2. BAS control dampers
 - 3. Terminal unit controls

1.3 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION

- A. Communications with Third Party Equipment:
 - 1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet interface for integration into the Direct Digital Control System described in this section (reference sequence of operations and points list for specifics). Those systems include:
 - a. Boilers
 - b. Chillers
 - c. Cooling Towers
 - d. Switchgear
 - e. Variable Speed Drives
 - f. Computer Room Units (MDF)
 - g. Rooftop Units

EQUIPMENT SHALL BID AS AN ALTERNATE

1.4 RELATED SECTIONS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. The following sections constitute related work:
 - 1. Division 01- General
 - 2. Division 23 – Mechanical
 - 3. Division 26 – Electrical

1.5 DESCRIPTION

- A. General: The control system shall consist of a complete BAS system with a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphics. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. If individual software seat licenses or keys are required provide a minimum of 4 additional licenses to accommodate multiple owner operators.
- B. If manufacture offers a web-based BAS platform, the installing contractor shall provide the new web-based software and software updates required for this project. Additionally, the installing contractor shall provide all computer related components (BAS web server – reference specifications for hardware requirements) for the new software platform to function in a peer-to-peer environment.
- C. The system shall directly control HVAC equipment as specified in Sequences of Operation. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints.
- D. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms specified shall be BACnet objects.

1.6 GENERAL REQUIREMENTS

- A. **No portion of the total contract will be declared substantially complete until the automatic temperature control system (BAS) has been demonstrated to be complete and functioning as intended. The temperature control system will be complete and functioning as intended when all of the space temperatures are maintained at plus or minus two degrees of set point.**
- B. **Building Automation System (BAS) Subcontractor shall participate in the third-party commissioning process. The self-checkout and testing shall still be required only after the Commissioning Agent CxA has tested and approved of the system. Functional testing conducted by the Commissioning Agent shall be performed with the participation of the Building Automation Systems subcontractor. In addition,**

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the BAS subcontractor shall provide appropriate personnel for functional testing procedures conducted by Commissioning provider.

- C. All warranties shall begin at substantial completion; warranties shall not begin at equipment start up or shipment.

1.7 APPROVED CONTROL SYSTEMS

- A. The following are approved control system suppliers, manufacturers, and product lines:

- 1. Refer to 01 23 00 ALTERNATES for acceptable manufacturers.**

1.8 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications

1. Installer shall have an established working relationship with Control System Manufacturer for a period of 10 years or greater. If the distributorship has not had duration of more than 10 years, the contractor will not be approved without the written approval prior to bid date (no exceptions).
2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.
3. BAS Graphics shall be Three Dimensional Thermographic.
4. BAS provider shall warranty controllers for 1 years.
5. BAS Provider shall provide lifetime training for the lifecycle of the facility to the owner at no additional cost.

1.9 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authority's codes and ordinances for these plans and specifications. At a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:

1. National Electric Code (NEC)
2. International Energy Conservation Code (IECC)
3. International Building Code (IBC)
4. Uniform Mechanical Code (UMC)
5. ASHRAE Standard 135-2016: BACnet - A Data Communication Protocol for Building Automation and Control Networks

1.10 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended

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hardware and software for operator workstation (server and browser for web-based systems).

1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 seconds.
2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.
3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
4. Object Command. Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 seconds.
6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.
7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 seconds of other workstations.
9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

Control Stability and Accuracy. Control loops shall maintain measured variable at set point within tolerances listed in Table 2.

Table1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±2°F
Ducted Air	±2°F
Outside Air	±2°F
Dew Point	±3°F
Water Temperature	±2°F
Delta-T	±0.25°F
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.

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Air Pressure (space)	±0.01 in. w.g.
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Note 1: 10% - 100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0-6 in. w.g. -0.1 to 0.1 in. w.g.
Airflow	±10% of full scale	
Space Temperature	±2.0°F	
Duct Temperature	±3°F	
Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1-150 psi 0-50 in. w.g. differential

1.11 SUBMITTALS

- A. Product Requirements: Provide one electronic copy and 4 hard copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. If requested, provide drawings as AutoCAD 2017 and 4 prints of each drawing on 8.5 x 11 paper and 1 electronic copy of each drawing. When manufacturer's cut sheets apply to a product series rather than a specific product, **clearly indicate applicable data by highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

1. Direct Digital Control System Hardware
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 1. Direct digital controllers (controller panels)
 2. Transducers and transmitters
 3. Sensors (include accuracy data)

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4. Actuators
5. Valves
6. Dampers
7. Relays and switches
8. Control panels
9. Power supplies
10. Batteries
11. Operator interface equipment
12. Wiring
- c. Wiring diagrams and layouts for each control panel. Show termination numbers.
- d. Floor plan schematic diagrams indicating field sensor and controller locations.
- e. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Central System Hardware and Software
 - a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 1. Central Processing Unit (CPU) or web server
 2. Monitors
 3. Keyboards
 4. Power supplies
 5. Battery backups
 6. Interface equipment between CPU or server and control panels
 7. Operating System software
 8. Operator interface software
 9. Color graphic software

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10. Third-party software
 - c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.
 - d. Network riser diagrams of wiring between central control unit and control panels.
 3. Controlled Systems
 - a. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - b. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified. Indicate alarmed and trended points.
 4. Description of process, report formats, and checklists to be used in Section 23 09 23 Article 3.15 (Control System Demonstration and Acceptance).
- B. Schedules
1. Within two months of contract award, provide schedule of work indicating:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item
 - d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations
 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- C. Project Record Documents. Submit 8 copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2017 and 6 prints of each drawing on 8 1/2" x 11" paper.

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2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of (Control System Demonstration and Acceptance).
3. Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs, and database on magnetic or optical media.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees, and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- D. Training Materials: The contractor shall provide training to owner personnel in a laboratory classroom environment. Each student shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. The instructors shall have CEU accreditation for all training courses offered.

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Provide documentation for this requirement in the initial BAS submittal. If contractor does not have CEU instructor or offer these courses locally include cost for tuition, travel and boarding to send students to manufacturer training facility. The owner shall receive free training for the life of the system.

1. Operator Overview – Consists of general system navigation, scheduling functions, setpoint modifications and parameter adjustments.
2. Advanced Topics Overview – Detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.
3. Program/Logic Manipulation – Modify system programs as needed for additions and modifications.
4. Graphic Manipulation – Modify system graphics as needed for additions and modifications.
5. Hardware Troubleshooting – Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.
6. Software Troubleshooting - Classroom setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common issues that can be utilized via software modifications.
7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and proper system modifications that can be made to enhance system performance and energy savings.
8. HVAC System Training – Objective of this class is to provide basic HVAC system knowledge of various types of systems including types of air side distribution and water side distribution. Topics such as thermodynamics, psychometrics, de-humidification, and demand control ventilation shall be thoroughly explained.

1.12 WARRANTY

A. Warrant work as follows:

1. Warrant materials for specified control system and peripheral control devices free from defects for a period of **1 years** after certificate of substantial completion. Warrant all labor for a period of **1 year** after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request. Additionally, contractor shall offer 24/7 after-hours support to include alarm monitoring and associated dispatch service.
2. Provide graphic modifications for a period of 3 years from date of substantial completion. This shall include room number and equipment modifications as requested by the owner.

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3. Provide telephone support free to the owner for a period of 3 years after substantial completion. This service includes technical support for all BAS equipment and shall include troubleshooting and problem resolution via the telephone or web services. Service shall be available during the hours of 7am to 5pm Monday – Friday.
4. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
5. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor or Owner identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
6. Exception: Contractor shall not be required to warranty existing devices except those that have been rebuilt or repaired during installation.

1.13 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
 1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ASHRAE/ANSI Standard 135-2016, BACnet.
- B. Use existing Ethernet backbone for network segments marked "existing" on project drawings.

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- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Sequence of Operations. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- E. Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- F. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- G. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable the system to both read and write data.
 - 1. System shall support Web services read data requests by retrieving requested trend data or point values (I/O hardware points, analog value software points, or binary value software points) from any system controller or from the trend history database.
 - 2. System shall support Web services write data request to each analog and binary object that can be edited through the system operator interface by downloading a numeric value to the specified object.
 - 3. For read or write requests, the system shall require username and password authentication and shall support SSL (Secure Socket Layer) or equivalent data encryption.

2.3 OPERATOR INTERFACE

- A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. Existing manufacturer's BAS web server and workstation can be utilized. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access

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Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:

1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.
 2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.
 3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.
 4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.
- B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ASHRAE/ANSI 135-2016, BACnet Annex J.
- C. Hardware. If providing a new server, each workstation or web server shall consist of the following:
1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times specified in Section 23 09 23 Paragraph 1.8. Hard disk shall have sufficient memory to store system software, one year of data for trended points specified in Sequences of Operation, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Web server shall be Compaq Rack Mounted Server (or equal) with a minimum of:
 - a. Dual Processor Intel Pentium 3.66 GHz processor
 - b. 1 GB RAM
 - c. 80 GB hard disk providing data at 100 MB/sec
 - d. RAID 5 Configuration
 - e. 128x CD-ROM drive
 - f. Most Current Windows Server Operating System

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- g. Serial, parallel, and network communication ports and cables required for proper system operation.
 - 2. If providing a server, the server shall support one or more the following database types:
 - a. SQL Server 2012 R2
 - b. PostgreSQL
 - c. MySQL
 - d. MS Access
- D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
 - 1. Log In and Log Out. System shall require username and password to log in to operator interface.
 - 2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 - 3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
 - 4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
 - 5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
 - 6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
 - 7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
 - 8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.
 - 9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

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E. System Software.

1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.
2. System Graphics: Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint. Graphics shall
 - a. Functionality: Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 - b. Animation: Graphics shall be able to animate by displaying different image files for changed object status.
 - c. Alarm Indication: Indicate areas or equipment in an alarm condition using color or other visual indicator.
 - d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.
3. System Configuration. Operators shall be able to configure the system.
4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
5. Security. System shall require a username and password to view, edit, add, or delete data.
 - a. Operator Access. Each username and password combination shall define accessible viewing, editing, adding, and deleting functions in each

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- system application, editor, and object. Authorized operators shall be able to vary and deny each operator's accessible functions based on equipment or geographic location.
- b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
- 6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
 - 7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 23 09 93. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.
 - 8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
 - 9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.
 - 10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.
 - 11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. The contractor shall configure all physical control points and software control points to accumulate trend data. Analog values shall be configured utilizing time-based intervals and digital values shall be configured for COV. Provide at a minimum of 250 samples per control point. If data can be stored locally at the controller level this information shall be archived at the central server or all BAS workstations.
 - 12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
 - 13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

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14. Standard Reports. Furnish the following standard system reports:
 - a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.
 - b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:
 1. Alarm History.
 2. Trend Data. Operator shall be able to select trends to be logged.
 3. Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
15. Custom Reports. Operator shall be able to create custom reports that retrieve data, including archived trend data, from the system, that analyze data using common algebraic calculations, and that present results in tabular or graphical format. Reports shall be launched from the operator interface.
16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
18. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
 - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
 - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to

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insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

- c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
 - d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
 - e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.
 - g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
 - 1. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
 - 2. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.
19. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.

2.4 CONTROLLER SOFTWARE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System Security. See Paragraph 2.3.F.5 (Security) and Paragraph 2.3.F.14.c.3 (Operator Activity).

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- C. Scheduling. See Paragraph 2.3.D.4 (View and Adjust Operating Schedules). System shall provide the following schedule options as a minimum:
 - 1. Weekly. Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 - 2. Exception. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 - 3. Holiday. Operator shall be able to define 24 special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- D. System Coordination. Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- E. Binary and Analog Alarms. See Paragraph 2.3.F.7 (Alarm Processing).
- F. Alarm Reporting. See Paragraph 2.3.F.9 (Alarm Reactions).
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Maintenance Management. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in Section 23 09 93.
- I. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93.
- J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs.
- K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- L. Energy Calculations.
 - 1. System shall accumulate and convert instantaneous power (kW) or flow rates (gpm) to energy usage data.
 - 2. System shall calculate a sliding-window average (rolling average). Operator shall be able to adjust window interval to 15 minutes, 30 minutes, or 60 minutes.
 - 3. System shall calculate a fixed-window average. Window interval start shall be defined by utility meter digital input signal to synchronize system's and utility's fixed-window averages.
- M. Anti-Short Cycling. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.

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- N. On and Off Control with Differential. System shall provide direct- and reverse-acting on and off algorithms with adjustable differential to cycle a binary output based on a controlled variable and setpoint.
- O. Runtime Totalization. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified.

2.5 CONTROLLERS

- A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), and Smart Actuators (SA) as required to achieve performance specified in Section 23 09 23 Article 1.8 (System Performance).
- B. BACnet.
 - 1. Building Controllers (BCs). Each BC shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Building Controller (B-BC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L.
 - 2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
 - 4. Smart Actuators (SAs). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ASHRAE/ANSI 135-2016, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.
 - 5. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC and ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
- C. Communication.

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1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
 2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
 3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
 4. Stand-Alone Operation. Each piece of equipment specified in Sequences of Operation shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.
- D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20°F to 140°F.
 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32°F to 120°F.
- E. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- F. Serviceability.
1. Controllers shall have diagnostic LEDs for power, communication, and processor.
 2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
 3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- G. Memory.
1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.

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- H. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
- I. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.
- C. Binary Inputs. Binary inputs shall monitor the on and off signal from a remote device. Binary inputs shall provide a wetting current of at least 12 mA and shall be protected against contact bounce and noise. Binary inputs shall sense dry contact closure without application of power external to the controller.
- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall send a pulsed low-voltage signal for pulse width modulation control or an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Pulse-Width Modulation. Control actuators designed for pulse-width modulation with a single binary output that cycle with variable on and off times as determined by the application software. Pulse-width modulation may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- J. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

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2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

- A. Motorized Control Dampers.
 - 1. Type. Control dampers shall have linear flow characteristics and shall be parallel- or opposed-blade type as specified below or as scheduled on drawings.
 - a. Outdoor and return air mixing dampers and face-and-bypass dampers shall be parallel-blade and shall direct airstreams toward each other.
 - b. Other modulating dampers shall be opposed-blade.
 - c. Two-position shutoff dampers shall be parallel or opposed-blade with blade and side seals.
 - 2. Frame. Damper frames shall 13-gauge galvanized steel channel or 1/8 in. extruded aluminum with reinforced corner bracing.
 - 3. Blades. Damper blades shall not exceed 8 inches in width or 48 inches in length. Blades shall be suitable for medium velocity (2000 fpm) performance. Blades shall be not less than 16 gauge.

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4. Shaft Bearings. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze, or better.
 5. Seals. Blade edges and frame top and bottom shall have replaceable seals of butyl rubber or neoprene. Side seals shall be spring-loaded stainless steel. Blade seals shall leak no more than (10 cfm per ft ²) at (4 in. w.g.) differential pressure. Blades shall be airfoil type suitable for wide-open face velocity of (1500 fpm).
 6. Sections. Damper sections shall not exceed 48 in. - 60 in. Each section shall have at least one damper actuator.
 7. Linkages. Dampers shall have exposed linkages.
- B. Electric Damper and Valve Actuators.
1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
 2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range.
 4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
 5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 60 inch -lb torque capacity shall have a manual crank.
 6. Acceptable Manufacturers:
 - a. Belimo
- C. Control Valves.
1. General. Select body and trim materials in accordance with manufacturer's recommendations for design conditions and service shown.
 2. Type. Provide two or three-way control valves for two-position or modulating service as shown.
 3. Water Valves.
 - a. Valves providing two-position service shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 1. Two-way: 100% of total system (pump) head.

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2. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 1. Two-position service: line size.
 2. Two-way modulating service: select pressure drop equal to the greatest of twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 35 kPa (5 psi).
 3. Three-way modulating service: select pressure drop equal to the smaller of twice the pressure drop through the coil exchanger (load) or 35 kPa (5 psi).
 4. Two-way and three-way modulating valve shall be one or two sizes smaller than the pipe size.
 - e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 1. Water zone valves: normally closed.
 2. Heating coils in air handlers: normally closed.
 3. Chilled water control valves: normally open.
 4. Other applications: as scheduled or as required by sequences of operation.
 - f. Acceptable Valve and Actuator Manufacturers:
 1. Belimo
- D. Binary Temperature Devices.
1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.
 2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 55°F-85°F setpoint range, 2°F maximum differential, and vented ABS plastic cover.
 3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft long. Element shall sense

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temperature in each 1 ft section and shall respond to lowest sensed temperature.
Low-limit thermostat shall be manual reset only.

E. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft² of duct cross-section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors: Space sensors shall be stainless steel flush plate mounted type.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

F. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%-80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of 40°F-170°F.
4. Humidity sensors shall not drift more than 1% of full scale annually.

G. Flow Switches. Flow-proving switches shall be thermal dispersion type (IFM U 40100 or approved equal) or differential pressure type (air or water service). Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Thermal dispersion type switches shall have relay output, wire break output and temperature output.
2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 4 enclosure unless otherwise specified.

H. Relays.

1. Control Relays. Control relays shall be plug-in type, UL listed and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

EQUIPMENT SHALL BID AS AN ALTERNATE

I. Override Timers.

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

J. Current Transmitters.

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500-ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

K. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

L. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500-ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

M. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

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N. Power Monitors.

1. Power monitors shall be three-phase type and shall have three-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
2. Power monitors shall provide selectable output: rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with 5 A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.

O. Current Switches.

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

P. Pressure Transducers.

1. Transducers shall have linear output signal and field-adjustable zero and span.
2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300 psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.

Q. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

R. Pressure-Electric (PE) Switches. PE switches shall be UL listed, pilot duty rated (125 VA minimum) or motor control rated, metal or neoprene diaphragm actuated, operating pressure rated for 0-175 kPa (0-25 psig), with calibrated scale minimum setpoint range of 14-125 kPa (2-18 psig).

1. Provide one- or two-stage switch action (SPDT, DPST, or DPDT) as required by application.
2. Switches shall be open type (panel-mounted). Exception: Switches shall be enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
3. Each pneumatic signal line to PE switches shall have permanent indicating gauge.

S. Local Control Panels.

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1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.9 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 23 09 23 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site.
 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If

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- installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Submittals. See Section 23 09 23 Article 1.9 (Submittals).
- C. Test and Balance.
1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
 2. Train Test and Balance Contractor to use control system interface tools.
 3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
 4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
- D. Life Safety.
1. Duct smoke detectors required for air handler shutdown are provided and wired under Division 26.
 2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23 and wired by Division 26.
 3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 26.
- E. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.
1. Communication media and equipment shall be provided as specified in Section 23 09 23 Article 2.2 (Communication).
 2. Each supplier of a control's product shall configure, program, start up, and test that product to meet the sequences of operation described regardless of where within the contract documents those products are described.
 3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

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- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.5 FIELD QUALITY CONTROL

- A. Commissioning and start-up of the BAS system shall be performed factory certified employees of the BAS contractor or manufacturer. Under no instances shall electrical subcontractors perform this work.
- B. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in Section 23 09 23 Article 1.7 (Codes and Standards).
- C. Continually monitor field installation for code compliance and workmanship quality.
- D. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.6 WIRING

- A. To differentiate BAS wiring from that of other trades, all cable except for underground will have a **yellow outer jacket** (no exceptions).
- B. Division 26 contractor shall supply a dedicated 120vac power to a junction box in each mechanical room for use by the BMCS.
- C. A Conduit fill based on plenum 18-gauge 2 conductor:
 - 1. 1/2 inch - No more than 4 conductors.
 - 2. 3/4 inch - No more than 8 conductors.
 - 3. 1 inch - No more than 12 conductors.
- D. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.
- E. All wires whether control network or device wire shall be marked with Brady-type markers.
- F. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
- G. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.

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- H. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- I. Install wiring in raceway where subject to mechanical damage and at levels below 10ft. in mechanical, electrical, or service rooms.
- J. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- K. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- L. Do not install wiring in raceway containing tubing.
- M. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at (5 ft) intervals.
- N. Contractor shall install all low voltage communication wiring as per all TIA/EIA communication cabling standards. All cabling shall be installed in dedicated cabling support such as j-hook, d-rings, or saddles. All supports shall be supported directly from building structure. Do not support cabling or supports from ceiling grid wire, conduit, ductwork, piping, or other system cabling. All cabling must be installed in independent support for that given system and may not share supports or run-in same conduit or support. All cabling shall be supported every 5'-0" from approved cabling support method. Contractor shall bundle all system cabling and label all wiring for system they serve. All cabling passing thru walls shall require dedicated conduit sleeves with bushing to protect cabling during installation. Contractor shall provide 1 meter service loops at all device termination locations and 3-meter service loops at all head end termination locations. All low voltage HVAC control cabling shall be yellow in color unless specified otherwise. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- O. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- P. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- Q. Include one pull string in each raceway 2.5 cm (1 in.) or larger.
- R. Use color-coded conductors throughout.
- S. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- T. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- U. Adhere to requirements in Division 26 where raceway crosses building expansion joints.

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- V. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- W. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- X. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft.) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size.
- Y. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.7 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.8 FIBER OPTIC CABLE

- A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.9 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.

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- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft. ² of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.10 FLOW SWITCH INSTALLATION

- A. Adjust flow switch according to manufacturer's instructions.

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3.11 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
 - 1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 - 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten linkage.
 - 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 4. Provide necessary mounting hardware and linkages for actuator installation.

3.12 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 in.) of termination.
- B. Label pneumatic tubing at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show instrument or item served.
- D. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- F. Label valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Label identifiers shall match record documents.

3.13 PROGRAMMING

- A. Point Naming. Name points as shown on the equipment points list provided with each Sequence of Operation. Where multiple points with the same name reside in the same controller, each point name may be customized with its associated Program Object number. For example, "Zone Temp 1" for Zone 1, "Zone Temp 2" for Zone 2.
- B. All DDC programming shall be accomplished through graphical programming, line code is unacceptable

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- C. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented.
 - 1. Application Programming. Provide application programming that adheres to sequences of operation specified in Section 23 09 93. Program documentation or comment statements shall reflect language used in sequences of operation.
 - 2. System Programming. Provide system programming necessary for system operation.
- D. Operator Interface.
 - 1. Standard Graphics. Provide graphics as specified in Section 23 09 23 Article 2.3 Paragraph E.2 (System Graphics). Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List located in the Sequence of Operation. Point information on graphics shall dynamically update.
 - 2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in Section 23 09 23.
 - 3. DDC screen graphic room numbers shall be based on final room graphics package. Obtain Architect/Owner approval of final room numbers prior to programming.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
 - 1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section 23 09 23.
 - 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 - 3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
 - 4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
 - 5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
 - 6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.

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7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
8. Alarms and Interlocks.
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 3.15 (Control System Checkout and Testing). Provide Engineer with log documenting completion of startup tests.
 1. Preliminary Review: At least 7 days prior to on-site demonstration, provide read-only username and password to Engineer for preliminary system review to be performed remotely. Engineer will review to verify all systems are connected and communicating and all points are reading properly, and graphics are complete. The Engineer will provide a report of any deficiencies. The contractor shall correct all deficiencies prior to on-site demonstration.
 2. On-site Demonstration: Engineer, Owner, contractor(s) and any/all factory authorized equipment representatives shall be present to perform, observe and review system demonstration. Notify Engineer/Architect at least 10 days before system demonstration is scheduled.
 - a. Demonstration shall follow process submitted and approved under Section 23 09 23 Article 1.9 (Submittals). Complete approved checklists and forms for each system as part of system demonstration.
 - b. Demonstrate actual field operation of each sequence of operation as specified in Section 23 09 93. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
 - c. Demonstrate compliance with sequences of operation through each operational mode.
 - d. Demonstrate complete operation of operator interface.
 - e. Demonstrate each of the following.
 - f. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall

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be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.

- g. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
- h. Building fire alarm system interface.
- i. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section 23 09 93. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section 23 09 23 Article 2.3 Paragraph F.11 (Trend Configuration).

- 3. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance.

- 1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
- 2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section 23 09 23 Article 1.9 (Submittals).

3.16 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

END OF SECTION 23 09 23

SECTION 23 09 23.18 - CARBON MONOXIDE MONITORING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract and the requirements of Section 15050 apply to the work specified in this Section.
- B. Gas detection system must meet or exceed Texas State Boiler Code 60.603-2015.
- C. ETL Listed to UL61010-1, CAN/CSA C22.2 No 61010-1, and LADBS Approved.
- D. Gas detection system must meet or exceed current OSHA and NIOSH alarm levels for personnel exposure to Carbon Monoxide.

1.2 SUBMITTALS

- A. **Provide line-by-line specification review annotated to certify compliance or deviation.**
- B. Submit in accordance with Division 1 and Section 23 05 00.
- C. Provide Monitor Panel as required to provide function in this specification and as shown on drawings.
- D. Provide panels with electrical characteristics shown on the electrical drawings.
- E. Carbon Monoxide system shall be third party validated to UL61010.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for operation, replacement parts, spare parts list, and wiring diagrams.

1.4 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for complete monitoring system. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup will not be acceptable.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) year's experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Monitoring system shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and

trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. International Gas Detectors Tocsin controller & detector range.
 - 2. Honeywell / Vulcain.

2.2 CARBON MONOXIDE (CO) GAS DETECTION SYSTEM

- A. Provide a CO gas detection system designed to measure the level of escaping heating plant exhaust gases in multiple monitoring areas.
- B. Gas detection must consist of a control panel that must be mounted outside of the risk area to enable pre-entry warning of room status and provide remote reset capability for the system (only once gas concentrations have reduced below any alarm levels).
- C. Gas detection system must be capable of being expanded to include flammable gas detection (to cover the fuel gas leakage and ignition/explosion risk) and refrigeration detection to enable interconnection to co-located Chiller Plant Areas without any loss of monitoring or alarm performance.
- D. **Shall be calibrated every (18) eighteen months and a record of calibration shall be posted in a conspicuous place.**
- E. Gas detection system enclosures for controllers or detectors should be a minimum of NEMA 3S (IP54).
- F. The gas detection system should consist of a central controller interconnecting with field mounted gas detectors of Electrochemical Cell technology. Interconnection between controller and field devices should be through a 2-core addressable multi drop highway highways depending on detector numbers and locations relative to controller. Detectors being mounted to best cover risk area according to current manufacturers and industry advice.
 - 1. The gas detection system should be an addressable type interconnecting to all field devices on a 2-core screen multi-drop highway. Controller should have a minimum of a single highway expandable to 32 gas detectors.
 - 2. Addressable highway should have polarity independent cores utilizing Sentinel+ addressable protocol enabling simple and quick install without need for core identifications. Addressable highway should have a capacity of 32 detectors.
 - 3. The gas detection system shall automatically and continuously monitor for CO over the range 0-100 ppm and compare concentrations to user-settable PPM limits per areas monitored for selected gas.
 - 4. Gas detection system to be capable of zoning alarm areas to enable a co-located Chiller Plant Room to be incorporated into locally fitted Heating Plant Room systems but provide independent alarms.

5. The gas detection system shall be capable of being calibrated specifically for CO over the range 0-100 ppm to enable compliance to local and national codes.
6. The gas detection system shall be capable of interconnecting with and monitoring Electrochemical Cell technology with factory and field calibrated settings. Measurement range for CO will be 0-100ppm with an accuracy of +/-3% as a percentage of full scale in ambient temperature ranges of 32 to 122 degrees Fahrenheit and 5 percent to 90 percent ambient humidity (non-condensing).
7. The gas detection system controller shall have a minimum of:
 - a. Common 24VDC 100mA output common to any alarm.
 - b. Four (4) SPCO alarm contacts -three (3) are for alarm levels and one (1) for system fault.
 - c. Three (3) indicator lights:
 1. green "on" for normal operation
 2. red "on" for alarm
 3. yellow "on" for system fault
 - c. Modbus RS485 output for connection to external devices with full Modbus Map freely available for 3rd parties.
 - d. Alarm and fault log capability for. Minimum of 1000 points.
7. All configuration and monitoring parameters on the gas detection controller may be accessed one or two ways concurrently:
 - a. Via web enabled devices accessing controllers on-board Wi-Fi pages; access must be Password protected.
 - b. Via Wi-Fi dongle connected onto detector (allowing access to all devices on highway); access must be password protected.
8. Three alarm levels shall be provided indicating three (3) independent "alarm" level conditions. Thresholds for all alarms are to be individually adjustable with a factory setting of 20 PPM for "Alarm 1", 50 PPM for "Alarm 2", and 100 PPM for "Alarm 3". To minimize false alarms, the unit's minimum/maximum alarm levels should be set at factory recommended settings in compliance with relevant local and national codes.
8. System should be capable of operation even though a fault occurs. Controller should have a fault Indicator light and display should detail nature of the Fault.
9. The gas detection system should have an electronics warranty of minimum 10 years; sensor warranty for CO to be a minimum of 3 years.
10. Periodic gas detection system bump testing, calibration and checking or adjustments shall be capable of being accomplished by one person. Gas detection system shall have a self-diagnostics and indication of diagnostic status. Diagnostics shall include the CO sensor/s.
11. Installation of gas detection system should follow manufacturers installation recommendations (see IGD 2 Wire Installers Guide).

2.3 GAS DETECTION CONTROL PANEL

- A. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

- B. The control panel should have an auto-setup function upon initiation. Upon first powering the device should ask for a FIND function that enables it to interrogate the connected highway, recognize and download details of all connected devices and automatically set channels and alarm points without any personnel interaction.
- C. The control panel provides remote programming, interrogation, and display functions to support the field mounted gas detectors. The system design supports compliance to the local and national codes.
- D. The control panel accepts a minimum of 1 Sentinel+ addressable input capable of monitoring up to thirty-two (32) field mounted detectors.
- E. Gas detector readings should be updated a minimum of once per second.
- F. Back lit LCD – The “Display” mode will display the measured point in PPM. The display will show a green backlight to reflect a safe condition and the light ring around the controller jog wheel will also be backlit green.
- G. The control panel should have the ability to log a minimum of 1000 events (alarms, resets, power activities etc.)
- H. Upon alarm, the channel display displays the channel in alarm (with live gas data), the backlit display changes from GREEN SAFE to RED , the light ring around the jog wheel changes from GREEN to RED, an internal 85dB sounder activates and the red alarm LED illuminates. Depending upon alarm Cause & Effect one or more of the SPCO, 230VAC 4Amp programmable relays change state.
- I. The LCD display indicates any input fault that may occur and identifies the fault area, upon FAULT the display will be backlit YELLOW, the light ring around the jog wheel changes from GREEN to YELLOW.
- J. The Control Panel shall provide Modbus RS485 to enable to operate in parallel with building management systems for the monitoring and interrogation of the control panel data.
- K. Control panel shall be able to “lock out” any instructions through the local keypad by password.
- L. Upon power failure, the control panel will have the capability to restart all individual monitors on the system. Upon return of electrical power, the control panel will be able to re-boot itself and return to operation without loss of programming or stored data (one month downtime without loss of data as a minimum).
- M. The control panel should be capable of operating devices up to 3000 feet from controller location dependent on cable core size and detector location.
- N. Two-way communication via Sentinel+ to a maximum of 32 detectors linked together in daisy-chain fashion is required. An onboard Wi-Fi port should enable password protected access by any web enabled device.
- O. The control panel shall have an operating temperature of 32° – 122°F.
- P. The control panel power consumption shall be less than 10 watts maximum 85-230VAC and be capable of running on 50 to 60 HZ power supply.
- Q. There shall be one common 24VDC output for local beacon sounders and four (4) relays in the monitor unit. Four (4) relays shall be available for customer connections. All relays shall be rated at 230VAC 4 AMP. Alarm relays shall be capable of being programmed within the gas detection range and options to be Rising or Falling, Latched alarms or Auto-reset, energized or none energized configurations.
 - a. ALARM 1: The Alarm relay connection shall be provided for the addition of an audible or visual warning device, fan activation or Plant shutdown. This relay will energize in the event that an area for Alarm 1 level has been exceeded.

- b. ALARM 2: The Alarm relay connection shall be provided for the additional of fan activation or plant shutdown. This relay will “energize” in the event that an area for Alarm 2 level has been exceeded.
 - c. ALARM 3: The Alarm relay connection shall be provided for the additional of fan activation or plant shutdown. This relay will “energize” in the event that an area for Alarm 3 level has been exceeded.
 - d. FAULT: The Fault relay shall be a normally energized relay automatically changing state upon FAULT or Power Loss.
- O. Unit power consumption shall be less than 50 watts maximum, 230 volts AC and be capable of running on 60 Hz supply.
- P. Program access to be denied by password to prevent unauthorized personnel from accessing the device. Program will automatically reset to full function settings following power interruption.
- Q. Gas detection. Controller must be capable of operating additional flammable detectors (for fuel gas leak detection within Heating Plant Room and/or refrigerant detectors for Chiller Room.
- R. Gas detection system to be capable of zoning alarm areas to enable Chiller Plant Room systems to be incorporated into locally fitted Heating Plant Room systems but provide independent alarms.
- S. Wiring connections shall be through 20mm electrical ports located on the bottom panel of the enclosure. Rear of control panel should be capable of being rotated to enable cable ports to be placed top or bottom. Rear panel knock outs should also be provided for cable entries.

2.4 GAS DETECTORS

- A. The gas detectors shall be electrochemical cell technology with factory and capable of field calibration.
- B. Gas detectors must be provided pre-calibrated and be able to interact with the control panel during its initial FIND operation to automatically set up the details of gas type, range and alarm points.
- C. Gas detectors shall be 2 wire addressable technology compatible with Sentinel+ protocol and polarity independent connection.
- D. Gas detectors shall have inboard I/O to enable (as a minimum) a 24VDC beacon sounder to be connected locally (maximum rating 100mA). Beacon sounder functions to be split for independent beacon & sounder operation (muting etc.).
- E. Gas detectors to have an onboard Volt Free SPCO Relay rated 230VAC 4 Amp to enable local switching of plant (ventilation, heating plant de-activation, solenoid closure etc.).
- F. Gas detectors should have a “hot swappable” front that enables gas sensors to be exchanged at end of life, upgraded, or swapped to other technologies or gas types upon plant change requirements.
- G. Measurement range for CO with an accuracy of +/- 3% of full scale in ambient temperature ranges of 32 to 122 degrees Fahrenheit and 5 percent to 90 percent ambient humidity (non-condensing).
- H. The gas detection system shall adhere to a temperature drift tolerance of 0.3 percent per degrees Celsius and have a sensitivity of 1 PPM (parts per million).
- I. Gas monitoring should be continuous.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install panels and all detectors as shown on the drawings. Sufficient clearances allow easy service, maintenance, and replacement components.
- B. Controller should always be placed outside of the Plant Room to enable pre-entry warning to personnel of room status.
- C. Remote reset capability for the system should be at the controller and external of the Heating Plant Room.
- D. Provide a combination strobe light and horn inside plant room to enable an evacuation alarm to be provided. The audible alarm shall be heard over the background room noise. The strobe light shall be energized when there is an alarm.
- E. Installation of gas detection system should follow manufacturers installation recommendations (see IGD 2 Wire Installers Guide).
- F. Demonstrate all functions of CO gas detection system.
- G. Train the Owner on operations and maintenance of CO detection system.

3.2 SEQUENCE OF OPERATION

- A. Refer to Section 23 09 93 Sequence of Operations for HVAC Controls for detailed CO sequence of operation requirement.
- B. Carbon Monoxide detection system shall monitor the presence of CO in the Heating Plant Room. If CO is detected, a scaled automatic system of room evacuation and plant shutdown will be initiated linked to detected gas concentrations. The following sequence shall also be initiated from a manual switch located on the CO detection system panel. The CO system supplier shall provide a "dry" set of contacts, initiated automatically. On activation of the contacts, the following sequence shall occur.
 - 1. Exhaust fan (Refer to plans for tag) shall be energized to high speed (if in place).
 - 2. Heating plant (refer to plans for tag) shall be de-energized to prevent further gas propagation.
 - 3. BAS to be informed of alarms.
 - 4. Provide an audible and visual alarm in the Heating Plant Room. Initiate the alarm and flash the light when the exposure limit is exceeded.
 - 5. Control sequence above shall be accomplished by hard wire interlocks.

3.3 DEMONSTRATION AND TRAINING

- A. Demonstrate system operations and verify specified performance. A functional test of the installed system shall be performed to demonstrate proper functioning of all interlocks and protective systems specified or otherwise required. This testing shall be conducted in the presence of the Owner's representative and the Engineer. The Contractor shall submit test procedure for approval by the Engineer prior to testing.

END OF SECTION 23 09 23.18

SECTION 23 09 93 - SEQUENCES OF OPERATION FOR HVAC CONTROLS

GENERAL:

- The BAS contractor shall provide all points listed under "Equipment Control Points" as well as any points required to accomplish the sequences of operation listed below. Refer to Specification 23 09 23 for input/output device specifications. Refer to contract drawings for additional items that may not be included in this specification. At the 11 month walk-thru, BAS contractor shall provide an additional DDC demonstration (in addition to the demonstration before substantial completion) and re-verification of point to point control of all equipment points and sequences with Owner and Engineer; no exceptions.
- BAS contractor shall schedule and participate in a pre-construction integration meeting with all vendors providing BACnet/Modbus or other equipment that is being integrated to the BAS. Sample graphics shall be submitted for owner review. The meeting is a requirement and shall include but not limited to:
 - Communications Requirements (MSTP/IP)
 - Points (Read/Write)
 - Connection Requirements (CAT5/6, 2-wire, 4-wire)
 - Coordinate Communication speeds when devices are MSTP.
 - Coordinate or Establish Device Instance Numbering System
 - Coordinate final points list(s) with owner/engineer
- BAS contractor shall provide and install all low voltage control wiring with conduit for equipment such as but not limited to chillers, boilers, split systems, rooftop units, CRAC units, unit heaters, dust collectors, welding equipment, etc. to facilitate communication between equipment.
- No portion of the total contract will be declared substantially complete until the graphics and automatic temperature control system has been demonstrated to be complete and functioning as intended. The BAS system will be complete and functioning as intended when all of the space temperatures are maintained at plus or minus two degrees of set point.
- BAS shall provide all new thermographic.
- BAS shall BACnet interface to all chillers, boilers, VFDs, utility meters, and equipment provided with on-board controls. Water and Gas meters to be provided by controls contractor. See schedule on mechanical plans.
- Any BACnet interfaced equipment must come with an onboard controller that is BTL listed. The BACnet controller must make all BACnet points available to the BMS.
- Equipment manufacturer for BACnet controlled equipment must provide onsite dedicated resources for the setup of the integration to BMS.
- Equipment provider must provide a certified controls start-up technician in order to assist with integration. This includes but is not limited to the following:
 - Inputting the device address, MAC address or IP address. (If equipment is to be BACnet/IP the equipment manufacturer shall be responsible for making sure the equipment points are pulled into customers network)
 - Ensuring appropriate points mapped and enabled. Assistance with pulling in points onsite is to be included for ALL equipment with on-board controls. Equipment controls technician is to be onsite with BAS Controls tech.
 - Equipment point Read/write option selection as needed.
 - All points pulled into onboard controller are reading properly through on-board controller and through the BAS interface, with points matching.

- BACnet Priority levels are not holding out commands from BAS.
 - The controls contractor is not responsible if there is a differentiation in how the on-board controls are programmed compared to the design SOO.
 - Remote technical assistance is not to be the BAS controls responsibility in order to troubleshoot and diagnose control through BACnet
- Building automation systems sub-contractor shall provide and install step down transformers in each mechanical room and run low voltage communication wiring power loops to serve low voltage actuators installed at each Air Terminal Unit.
- All BAS exposed control wiring below the ceiling and especially outdoors (rigid) shall be in conduit; furnished and installed by bas subcontractor.
- Outside Air Handling Units and any units with factory mixing box section shall be provided with factory mounted dampers; BAS contractor shall provide actuator. Coordinate with unit's manufacturer for damper sizes.
- Zone Sensors located in common areas shall have a lockable plastic cover. Sensors in the gymnasium must be mounted above any potential padding. Provide additional sets of keys.

HARGRAVE HIGH SCHOOL ADDITION:

1. CHILLED WATER SYSTEM – VARIABLE PRIMARY PUMPING (ACCH-01, ACCH-02, ACCH-03 & ACCH-04)

Central plant consists of four (4) equal sized air-cooled chillers with dedicated primary chilled water pumps; refer to mechanical piping plans. **Each chiller shall be provided with a BACnet interface for read and write capability; BAS subcontractor to run communication wiring to each chiller.**

Equipment Control Points:

Plant CHW Supply Temperature – AI
Plant CHW Return Temperature – AI
Plant CHW Flow – AI
New Gym CHW Supply Temperature – AI
New Gym CHW Return Temperature – AI
New Gym CHW Flow – AI
Building CHW Differential Pressure – AI
Chiller Amps/Status, each chiller – AI
Chiller CHW Supply Temperature, each chiller – AI
Chiller CHW Return Temperature, each chiller – AI
Chiller Panel Output Contacts, each chiller – AI
Chiller Alarm, each chiller – DI
Chiller Start/Stop, each chiller – DO
Pump Start/Stop, each pump – DO
Pump Status, each pump – DI
Pump Speed Control, each pump – AO

Chilled Water System Activation

The chilled water system shall be activated by a request for cooling from any unit it supplies with chilled water. The number of cooling requests required and the length of time the requests must be received before activating the plant shall be operator adjustable. The chilled water system shall be disabled if the outside air temperature is less than 45°F (operator adjustable).

Chiller Activation

When a chiller is activated, the BAS shall send a start command to the chiller controller. The BAS shall wire the pump aux. output contacts from the main chiller controller as inputs into the BAS controller. Upon receiving an input to start the pump from the chiller controller, the BAS shall send the start command to the associated dedicated CHW primary pump starters. If the chiller alarm input closes (indicating that the chiller has alarm), the BAS shall generate an alarm at the central site computer, discontinue the start signal to the chiller.

Chilled Water Temperature Control

The chiller's internal controls shall maintain its chilled water supply temperature set point of 44°F (locally adjustable).

Chiller Sequencing

A current sensor at each chiller shall monitor the amperage of each chiller. The BAS shall also receive temperature input from sensors mounted in the building's common supply and return piping. If the enabled chiller or chillers current load monitor indicates that the chiller or chillers are operating above 95% (adjustable) capacity, and the building supply water temperature rises greater than 3°F (adjustable) above set point for five (5) minutes (adjustable) the next chiller in sequence shall be enabled into operation by the above-described sequence.

With more than one chiller operating, if the combined load decreases to 80% (adjustable) capacity of the previous state for ten (10) minutes (adjustable) and the building supply water temperature is less than 3°F (adjustable) above set point, a chiller shall be de-energized. The chiller programming shall be set up so that the owner can choose the increment/decrement sequence of the chillers for associated modes.

The equal size chillers shall be lead-lag alternated weekly at operator adjustable time and day of the week by the BAS based upon cumulative runtime.

Chillers shall run for a minimum of 10 minutes (adjustable) to prevent short cycling, and their chilled water pumps shall continue to run for an additional 5 minutes (adjustable) to ensure adequate flow during shutdown.

Chilled Water Differential Pressure Control

The chilled water loop is a Variable-Primary Flow (VPF) pumping system with Variable Speed Drives (VSD's) on each pump. A differential pressure sensor across the building chilled water supply and return lines located in the central plant mechanical room shall monitor building differential pressure across the mains. The differential pressure sensor shall be used to control the speed of the CHW pumps to maintain the system differential pressure setpoint (adjustable). When chilled water pumps are operating, the speed of pumps will be modulated to maintain differential pressure setpoint.

The BAS shall monitor the position of all the chilled water valves of the units that the plant serves and the differential pressure setpoint shall be reset based on achieving a target valve position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The chilled water flow shall not change by more than 10 percent per minute. The target valve position, the reset time, the dead band, and the rate of change values shall be operator adjustable.

Freeze Protection

When the outdoor air temperature drops to 34°F (adjustable) or below, the BAS shall open the chilled water valves for flow through the coils for freeze protection and the primary chilled water pumps shall be activated to run until the low ambient temperature ceases to exist.

Equipment OFF Conditions

When the chilled water system is inactive, the chillers and chilled water pumps shall be off.

2. HEATING WATER SYSTEM (NEW GYM BOILER – B-01)

The heating water system is a fully condensing boiler hot water system with primary/secondary pumps and condensing boiler. The boiler system shall be controlled by a sequencing panel provided by the boiler manufacturer equipped with a BACnet interface card for the boiler. The BAS contractor shall provide a BACnet interface to the boiler to communicate with the sequencing panel to request the heating water system and monitor pertinent data from the boilers such as but not limited to leaving water temperature, status, alarm, etc.

The controls contractor shall provide capability for S/S for the boiler in order for end-user to start the boiler if master boiler controller or BACnet interface is down.

BAS shall provide low voltage control wiring and conduits connecting the boilers and for the end devices. BAS to provide conduit and communication wire between boilers.

Equipment Control Points:

Building HW Supply Temperature – AI
Building HW Return Temperature – AI
Building HW Return Flow Meter – AI
Boiler Supply Temperature – AI

Boiler Status – DI
Boiler Alarm – DI
HW Pump Status – DI
Boiler System Enable – DO
HW Pump Start/Stop – DO
Carbon Monoxide Level – AI
Boiler Room Space Temperature – AI
Boiler Room Supply Fan Start/Stop - Hardwired to Damper End Switch
Boiler Room Supply Fan Status – DI
Boiler Room Supply Fan Damper w/End switch– DO/HW 24v to fan S/S
Boiler Room Exhaust Fan Start/Stop -DO
Boiler Room Exhaust Fan Status – DI
Boiler Manufacturer Provided Headered Temperature Sensor – AI

Heating Water System Activation

The heating water pump shall be activated by a request for heating from any equipment it supplies with heating water. A current switch shall prove status to the BAS and shall alarm at the central site if the contacts are not made within 20 seconds (adjustable). Once the heating water pump has proven positive flow, the BAS shall request the boiler system to run.

If the hot water supply temperature is less than 100°F (adjustable) or the building hot water pump status is not indicating the building hot water pump is running, the BAS control module shall broadcast that hot water is not available.

The BAS shall enable the system.

Heating Water Temperature Reset: The heating water shall have a ratio

Reset based on outside air temperature and the following schedule:

Outside Air Temp	Less than 50°F	Hot Water Temp	140°F
Outside Air Temp	Greater than 70°F	Hot Water Temp	100°F

Carbon Monoxide Monitoring

A carbon monoxide sensor installed in the boiler room will alarm the BAS and shut down the boiler. The BAS shall notify district maintenance personnel via e-mail and text message when the level of carbon monoxide rises above 100 ppm. The sensor should also alarm the BAS and shutdown the boiler upon loss of power to the sensor. The boiler room supply fan will be de-energized, and the emergency exhaust fan will be energized to dilute the carbon monoxide levels in the room. A strobe light and audible alarm at the panel will be activated during an event. A push button on the panel will silence the alarm and reset the system. Carbon monoxide sensor shall be calibrated every eighteen months, and a record of calibration shall be posted in a conspicuous place.

Freeze Protection

When the outdoor air temperature drops to 35°F (adjustable) or below, the BAS shall open the hot water valves for the flow through the coils for freeze protection. The hot water system shall be activated to run and the building HW supply set point shall be set to 85°F (adjustable) while running the boiler only until the low ambient temperature ceases to exist or the building start-up time arrives.

Boiler Room Supply Fan

The BAS shall start/stop the supply fan to maintain a space temperature of 80°F (adjustable) during occupied and unoccupied modes.

3. SINGLE ZONE VAV AIR HANDLING UNITS WITH HUMIDITY CONTROL AND DEMAND CONTROL VENTILATION (AHU-C1-01 & AHU-C1-02)

Equipment Control Points

Space Sensors – AI (Combo Temp, Humidity & CO₂)
Discharge Air Temperature – AI
Cooling Coil Discharge Air Temperature – AI
Reheat HW Coil Discharge Air Temperature - AI
CO₂ Level(s) – AI
Airflow Measuring Station – AI
Fan Status – DI
Filter Status – DI
Air Handling Unit Fan start/stop – DO
Fan Speed Control – AO
Chilled Water Valve Control – AO
Hot Water Re-Heat Valve Control - AO
OA Damper Control – AO

AHU Activation

The air-handling unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The air-handling unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control

When the air handler is requested to run, the B.A.S. control module shall send an enable signal to the air handler inverter, which will energize the fan. A current switch shall prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms. A run request shall be sent to the Chilled Water System when the air-handling unit is active, and cooling is required. A run request shall be sent to the Heating Water System when the air-handling unit is active, and heating is required. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Temperature Control

A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the chilled water and heating water control valve actuators in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Outside Air Control (Demand Control Ventilation)

When the air handler is running in the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the OAHU that supplies the unit with outside air. A CO₂ sensor mounted in various spaces as indicated on drawings, shall monitor the CO₂ level (see series fan powered box sequence). The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO₂ level between 850 ppm and 1,000 ppm (all adjustable). If the CO₂ level rises above 1,200 ppm an alarm shall be sent to the central site. OA dampers minimum and maximum positions shall be determined by the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM. The B.A.S. shall select the highest level when more than one CO₂ sensor is used to modulate the damper. The system shall have the ability to perform a "Purge Mode" at a scheduled time for a scheduled duration.

The outside air damper shall remain closed, and the OAHU shall remain off even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule. The dedicated OAHU will modulate fan speed to maintain duct static pressure.

The outside airflow shall be measured by the flow measuring station and reported to the BAS. The BAS shall increase and decrease the outside airflow of the unit to meet the demand control ventilation sequence.

Space Humidity Control

A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55°F (adjustable) and modulate the chilled water valve to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the hot water reheat valve to maintain the space temperature between its heating and cooling setpoints. If the B.A.S. control module is receiving a broadcast from the HW system that heating water is not available (see Heating Water System sequence of operations) the chilled water valve shall not be overridden until heating water is available. The fan will run at a fixed speed (determined by the TAB contractor) while in dehumidification mode.

Unoccupied Control

If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

If the space humidity reaches the operator adjustable unoccupied setpoints of 60% (adjustable), the required equipment shall be started and run to maintain the space humidity within the setpoints. All values are operator adjustable.

Humidity setpoints supersedes the temperature setpoints. The BAS shall initiate an alarm if temperature or humidity rises above unoccupied setpoint.

Associated Equipment

During the occupied time period, the outside air damper shall be open. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The outside air dampers shall remain closed, the exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule. The Exhaust fans shall be commanded (off) during morning cool down / warm up and shall only turn on during the occupied time periods. General exhaust fans may require a separate schedule to accomplish this sequence and will be part of the commissioning sequence of operations to be demonstrated.

An airflow switch shall monitor the pressure across the air filter. A contact closure from the air filter switch will alarm and notify maintenance through the B.A.S. of a dirty filter.

Equipment off Conditions

When the air-handling unit is de-energized, its chilled water valve, hot water valve and OA damper shall be closed. The related exhaust fans shall be de-energized and the request to run to the OAHU shall be canceled.

Freeze Protection

While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the primary pumps shall run for freeze protection.

4. DUAL DUCT AIR HANDLING UNITS WITHOUT DEMAND CONTROL VENTILATION

(AHU-C1-03 & AHU-16 (EXISTING UNIT))

Equipment Control Points

Cold Deck Temperature – AI
Hot Deck Temperature – AI
Cold Deck Static Pressure – AI
Hot Deck Static Pressure – AI
Cold Deck High Static Limit – DI
Hot Deck High Static Limit – DI
Return Air Temperature – AI
Air Handler Fan Status – Current Switch - DI
Filter Status – DI
Chilled Water Valve Control – AO
Hot Water Valve Control – AO
Fan Speed Control – AO
Air Handling Unit Fan Start/Stop – DO
Outside Air Damper Control – DO

AHU Activation

Each Dual Duct VAV air handler shall be activated by a request to run from any Dual Duct VAV box it serves.

Fan Control

When the air handler is requested to run, the B.A.S. control module shall send signal to the air handler inverter, which will energize the fan. A current switch shall prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. A run request shall be sent to the Chilled Water System when the air-handling unit is active, and cooling is required. A run request shall be sent to the Heating Water System when the air-handling unit is active, and heating is required.

Temperature Control

Averaging element type temperature sensors covering the entire length of the cooling and heating coils shall monitor the Cold Deck and Hot Deck temperatures.

The Cold Deck control shall be enabled after the minimum request (2, adjustable) for cooling is received for three minutes from a Dual Duct VAV Box it serves as long as the outside air temperature is greater than 45°F. The number of cooling requests required, the delay duration, and the outside air temperature lockout shall be operator adjustable. When the Cold Deck control is enabled, the BAS shall modulate the chilled water control valve as required to maintain the Cold Deck temperature at a set point of 55°F (operator adjustable) or as noted on the Air Handling Unit schedule on the drawings or the operator shall be able to select that the Cold Deck set point shall be reset based on cooling requests from the Dual Duct VAV Boxes it serves. The reset based cooling request shall be between of 54°F and 57°F based on the number and the duration of the cooling requests. The cold deck set point shall not change by more than 1/2 degree every three minutes with all temperature, reset time, and rate of change values operator adjustable.

The Hot Deck control shall be enabled after the minimum request (2, adjustable) for heating is received for three minutes from a Dual Duct VAV Box it serves as long as the outside air temperature is less than 65°F. The number of heating requests required, the delay duration, and the outside air temperature lockout shall be operator adjustable. When the Hot Deck control is enabled, the BAS shall modulate the hot water control valve as required to maintain the Hot Deck temperature at set point. The operator shall be able to select that the Hot Deck set point shall be reset based on the outside air temperature or based on heating requests from the Dual Duct VAV Boxes it serves. The outside air temperature reset schedule shall be a linear reset schedule with the initial setpoints of an 80°F hot deck at 65°F outside air temperature and 100°F hot deck at 36°F. All of the values shall be operator

adjustable. The reset based heating request shall be between 80°F and 100°F based on the number and duration of the heating requests. The hot deck set point shall not change by more than 1 degree every five minutes with all temperature, reset time, and rate of change values operator adjustable.

Air Volume Control

The B.A.S. control module shall receive an input from a static pressure sensors located 2/3 down the longest heating duct and cooling duct runs. In response, the B.A.S. shall select the static pressure sensor that is lowest as compared to the static pressure set point and send a modulating signal to the variable speed drive, which will adjust the fan speed to maintain the static pressure at a set point of 1.5" (operator adjustable) or as determined by the balancing contractor to be the lowest setting required to allow the Dual Duct VAV Boxes to meet their air flow setpoints. A minimum airflow setting determined by TAB shall be required for each duct to prevent unnecessary HSL trips. The B.A.S. shall monitor the position of all of the heating and cooling dampers in the boxes that the air handler serves, and the static pressure set point shall be reset based on achieving a target damper position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The static pressure set point shall not change by more than 1/8 inch every two minutes. The target damper position, the reset time, the dead band, and the rate of change values shall be operator adjustable.

Manual reset high static limit switches located in the discharge of the air handlers heating and cooling ducts shall de-energize the air-handling unit if static pressure exceeds 3.0" w.g. (locally adjustable) in either duct.

Associated Equipment

During the occupied time period a request to run shall be sent to the OAHU that supply's its outside air. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The OAHU's and exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

An airflow switch shall monitor the pressure across the air filter. A contact closure from the air filter switch will alarm and notify maintenance through the B.A.S. of a dirty filter.

Equipment off Conditions

When the air-handling unit is de-energized, its chilled water valve and hot water valve shall be closed. The related exhaust fans shall be de-energized and the request to run to the OAHU shall be canceled.

Freeze Protection

While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the primary pumps shall run for freeze protection.

5. CONSTANT 100% OUTSIDE AIR HANDLING UNITS (OAHU-C1-03)

Equipment Control Points

Discharge air temperature – AI
Discharge CHW coil air temperature – AI
Preheat HW coil air temperature – AI
Air handling unit fan status – current switch - DI
Freeze stat – DI
CHW valve control - AO
HW pre-heat valve control - AO
Fan speed control – AO
Outdoor air damper – DO
Damper End Switch – DI
Outdoor air handling unit start/stop – DO

Unit Activation

When the outdoor air handling unit is requested to run by an air handler it serves, the Building Automation System (B.A.S.) shall first open the outside air damper and the actuator's internal end switch will close when the damper is open allowing the outdoor air unit to be started. The B.A.S. shall send a signal to the outdoor air handling unit inverter, which will start the fan. A current switch shall prove status to the B.A.S. and shall alarm at the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. The outdoor air damper shall be fully open before the outdoor air handling unit fan can be energized in either the hand or auto position.

Temperature Control

When the outdoor air handling unit is active, and heating is required a duct temperature sensor mounted downstream of the pre-heat coil will modulate the pre-heat valve to maintain the operator adjustable pre-heat discharge air temperature set point of 55°F (adjustable). If cooling is required a duct temperature sensor mounted in the unit's supply air stream shall monitor the unit's supply air temperature and modulate the chilled water valve to maintain the operator adjustable discharge air temperature set point. The operator shall be able to select if the supply air cooling set point shall be reset based on the outside air temperature or use an operator adjustable set point of 55°F. The outside air temperature reset schedule shall be a linear reset schedule with initial setpoints of 58°F supply air at 60°F outside air temperature and 55°F supply air at 75°F. The pre-heat control shall be disabled if the outside air temperature is greater than 55°F and the supply air cooling control shall be disabled if the outside air temperature is less than 53°F. All of the values shall be operator adjustable.

Freeze Protection

A manual reset freeze stat mounted in the discharge air stream of the pre-heating coil shall open the HW control valves to 30% and CHW control valves to 50% (adjustable), close the outside air damper, de-energize the outside air handling unit fan, energize a primary chilled water pump, a secondary hot water pump and boilers (see heating water sequence of operation), and alarm at the central site if the leaving air temperature drops to 34°F (locally adjustable). The freeze stat must be manually reset once the temperature rises above the trip point.

Equipment off Conditions

When the outdoor air-handling unit is off, it's chilled and heating water valves shall be closed, and the outdoor air damper shall also be closed. If the outside air temperature drops below 34°F (operator adjustable), the B.A.S. shall open hot water valve to 30% and chilled water valves to 50% (adjustable).

6. VARIABLE AIR VOLUME OUTSIDE AIR HANDLING UNIT WITH ENERGY RECOVERY WHEEL (QAHU-C1-01 & QAHU-C1-02)

Equipment Control Points

Discharge air temperature – AI
Discharge CHW coil air temperature – AI
Discharge preheat HW coil air temperature – AI
Wheel Outside Air leaving temperature – AI
Wheel Outside Air entering temperature – AI
Wheel Exhaust leaving air temperature – AI
Wheel Exhaust entering air temperature – AI
Duct Static Pressure – AI
Outside air flow – AI
Exhaust air flow – AI
Supply fan status – current switch – DI
Exhaust fan status – current switch – DI
Static pressure high limit switch – DI
Freeze alarm – freeze stat mounted upstream of CHW coil – DI

Supply Fan start/stop – DO
Exhaust fan start/stop – DO
Energy recovery wheel start/stop - DO
CHW valve control - AO
HW pre-heat valve control - AO
Supply fan speed control – AO
Exhaust fan speed control – AO
Energy Recovery wheel control - AO
Outdoor air damper, with end switch – DO / DI
Exhaust damper with end switch – DO / DI

Unit Activation

The outdoor air handling unit shall be requested to run by any air handler it serves.

Fan Control

When the air handler is requested to run, the BAS controller will send a signal to the outside air damper and exhaust air damper to open. Upon receiving a signal from both damper end switches, the respective fans shall be commanded to run. A current switch on each fan will prove status to the BAS and alarm the central site if either switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms.

The AHU outside air fan and exhaust fan ramp speeds shall be configured in the VFD drive, by the start-up unit manufacturer and set to ensure that it takes no less than 3 minutes for the unit fans to ramp to the controlled setpoints.

Temperature Control

When outdoor air handling unit is active, and heating is required, an averaging temperature sensor mounted downstream of the pre-heat coil will modulate the pre-heat valve to maintain the pre-heat discharge air temperature set point of 55°F (adjustable). If cooling is required, an averaging temperature sensor mounted in the unit's supply air stream shall monitor the unit's supply air temperature and modulate the chilled water valve to maintain the discharge air temperature set point. The operator shall be able to select if the supply air cooling set point shall be reset based on the outside air temperature or use a set point of 55°F. The outside air temperature reset schedule shall be linear with initial setpoints of 58°F supply air at 60°F outside air temperature and 55°F supply air at 75°F. The pre-heat control shall be disabled if the outside air temperature is greater than 55°F and the supply air cooling control shall be disabled if the outside air temperature is less than 53°F. All the values shall be operator adjustable.

There shall be a manual reset freeze stat mounted in the discharge air stream of the pre-heating coil. If the freeze stat trips, the BAS shall open the HW control valve to 30% (adjustable), CHW control valve to 50% (adjustable), close the outdoor air damper, de-energize the outside air fan, close the exhaust air damper and de-energize the exhaust fan. Alarm at the central site if the leaving air temperature drops to 34°F (locally adjustable). The freeze stat must be manually reset once the temperature rises above the trip point.

Air Volume Control

While the air handling unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable, final setpoint to be determined by TAB contractor) by modulating the speed of the supply fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply duct. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the air handling unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.

The EF VFD shall ramp in sequence with the SF VFD. The offset and speeds shall be set by the TAB contractor to insure the design flow CFMs are met.

Energy Recovery Wheel

When the air handler is in occupied mode, the energy recovery wheel shall be started.

When the outside air entering temperature is greater than the exhaust air entering temperature, the wheel shall operate in cooling mode at its full effectiveness and maximum speed of 20 RPM.

When the outside air entering temperature reaches frost control setpoint, 34°F (adjustable), the wheel's speed shall be modulated to avoid ice formation within the wheel's media.

When outside air entering temperature is lower than the exhaust air entering temperature, but supply air temperature reaches the free cooling setpoint, 60°F (adjustable), the wheel's speed shall be modulated to prevent the supply air from exceeding the free cooling setpoint.

When outside air entering temperature is lower than the exhaust air entering temperature; when the outside air entering temperature is above the frost setpoint, 34°F (adjustable), and supply air temperature is below the free cooling setpoint, 60°F (adjustable), the wheel shall operate in heating mode at its full effectiveness and maximum speed of 20 RPM.

Freeze Protection

A manual reset freeze stat mounted in the discharge air stream of the pre-heating coil shall open the HW control valves to 30% and CHW control valves to 50% (adjustable), close the outside air damper, de-energize the outside air handling unit fan, energize a primary chilled water pump, a secondary hot water pump and boilers (see heating water sequence of operation), and alarm at the central site if the leaving air temperature drops to 34°F (locally adjustable). The freeze stat must be manually reset once the temperature rises above the trip point.

Equipment off Conditions

When the outdoor air-handling unit is off, it's chilled and heating water valves shall be closed, the outdoor air damper shall also be closed, supply and exhaust fans shall be de-energized, and the return air damper shall be fully open. If the outside air temperature drops below 34°F (operator adjustable), the BAS shall open the chilled water valve to 50% (adjustable), the hot water control valve to 30% (adjustable), and a signal shall be sent to the plant to run for freeze protection.

7. DUAL DUCT TERMINAL UNITS

Equipment Control Points

Space temperature – AI
Discharge Air Temperature - AI
Cold deck flow – AI
Hot deck flow - AI
Cooling damper - FM
Heating damper – FM (floating motor)

Zone Occupancy

Each dual duct terminal box shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outdoor air temperature -- all variables are operator assignable from the central site.

Temperature Control

When the zone becomes occupied, the air terminal unit controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall

be modulated open to its maximum cooling CFM setpoint (adjustable) and a run signal shall be sent to the air handling unit serving the terminal box. As the space temperature returns to setpoint, the terminal box controller cold air damper shall modulate to its minimum cooling CFM setpoint of 50% (adjustable) of maximum CFM. If heating is required, the heating damper shall modulate open to 60% (adjustable) of maximum CFM and the cooling damper shall close. If the temperature continues to drop, the heating damper shall modulate open to 100% (adjustable) of maximum CFM. The sequencing of the cooling and heating dampers shall maintain a minimum air flow of 50% (adjustable) of maximum CFM.

Unoccupied Control

During the unoccupied time period, the terminal box cooling and heating dampers shall be closed. If the space temperature reaches the unoccupied heating or cooling setpoints, the required equipment shall be started and run to maintain the space temperature within these setpoints: 55°F (adjustable) heating and 90°F (adjustable) cooling typical.

8. HYDRONIC FAN COIL UNITS WITH RE-HEAT COIL (FCU-C-01 & FCU-C-02)

Equipment Control Points

Space Sensors – AI (Combo Temp & Humidity)
Discharge air temperature – AI
Fan status – DI
Chilled water valve – AO
Re-heat valve – AO
Fan start/stop – DO
Outdoor air damper – DO
Float Switch – DI (Suspended Ducted Units Only)

Zone Occupancy

Each unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature versus the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site.

Fan Control

When the calculated start time arrives, the BAS shall energize the fan. A current switch shall prove status to the BAS and shall alarm at the central site if the switch is not made within 40 seconds (adjustable).

Space Temperature Control

A temperature sensor shall monitor the air temperature in the space. The BAS shall modulate the chilled water and hot water control valve, in sequence, to maintain the space temperature within setpoint.

Space Humidity Control

A humidity sensor shall monitor the humidity in the space. When there is a call for dehumidification, the BAS shall open the chilled water valve to maintain a 55°F cold deck temperature and shall modulate the reheat valve to maintain the occupied cooling & heating setpoint. If heating is not available dehumidification mode shall be deactivated.

Outside Air

When the unit is in occupied mode, the BAS controller shall open the outside air damper.

Associated Equipment

During the occupied time period, any associated exhaust fans shall be energized.

Unoccupied Control

During the unoccupied time period, if the space temperature reaches the unoccupied heating or cooling setpoints (55°F heating and 95°F cooling, adjustable) the required equipment shall be started and run as normal to maintain the space temperature within these setpoints.

Equipment Off Conditions

When the unit is off, the chilled water and hot water valves shall be closed, the outside air damper shall be closed, and any associated exhaust fans shall be de-energized. A float switch shall monitor the moisture/water level in the drain pan. The unit shall shutdown when overflow is detected.

Freeze Protection

While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the primary pumps shall run for freeze protection.

9. DUCTLESS MINI-SPLIT-SYSTEM AIR CONDITIONERS

The split systems shall have a factory furnished controller and operate stand-alone based on unit thermostat. The BAS shall monitor the space temp only. Thermostat provided by unit manufacturer and installed by BAS.

Equipment Control Points

Space temperature – AI (monitoring only)

10. GENERAL EXHAUST FANS

Equipment Control Points

Exhaust fan status – DI

Exhaust fan enable – DO

Motorized Damper – DO (where indicated on drawings)

Interlock all general exhaust fans to run with air handling equipment serving the same area and run only during the occupied mode with their OA Dampers open. The exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule. Where exhaust fans have associated motorized dampers (in-line exhaust fans), BAS contractor shall provide dampers and actuators and necessary interlock wiring to allow damper to open whenever the exhaust fan is running.

11. BOILER ROOM SUPPLY FAN

Equipment Control Points

Exhaust fan status – DI

Exhaust fan start/stop – DO

Interlock boiler to operate whenever heating water system is operating. BAS shall report an alarm if the fan fails to start.

12. OUTDOOR AIR CONDITIONS

Equipment Control Points

Outdoor air temperature – AI

Outdoor air humidity - AI

The sensors shall be mounted in an area on the north side of the building where the representative temperature and humidity can be monitored, both shall have sun shields. Based on the outside air temperature and humidity the BAS shall calculate the outdoor enthalpy, wet bulb, and dew point

temperatures. The outdoor air temperature and humidity shall be broadcast as global information for use by the other control programs.

13. OUTSIDE AIR INTAKE HOODS

Equipment Control Points

Damper open/close – DO

When the associated Air Handling Unit is in occupied mode, the BAS controller shall open the outside air damper. Damper and actuators provided by Intake Hood manufacturer, wiring and installation by BAS.

14. BUILDING RELIEF HOODS

Equipment Control Points

Isolation damper OPEN / CLOSE - DO

Damper Position Status – DI

The BAS shall OPEN each motorized relief damper when the associated area is occupied. An internal Barometric damper shall OPEN/ CLOSE according to interior building air pressure.

Damper and actuators provided and installed by BAS.

In the event of a Shelter in Place shutdown all motorized Relief dampers shall be CLOSED.

15. COOL-DOWN CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the cool-down cycle shall be regulated by the BAS optimum start/stop routine. The cool-down cycle shall continue until all space temperatures are at or below the setpoint. Cool-down cycle shall not be initiated when outside air temperature is less than 80°F.

16. WARM-UP CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the warm-up cycle shall be regulated by the BAS optimum start/stop routine. The warm-up cycle shall continue until all space temperatures are at or above the setpoint. Warm-up cycle shall not be initiated when outside air temperature is greater than 70°F.

17. LOAD SHEDDING

Provide load shedding capabilities via software. This should include setpoint relaxation, setpoint reset and shutdown of equipment. Coordinate equipment shutdown with the owner.

The user shall have the ability to have 8 levels of adjustment to reduce the electrical demand of the facility. Each level shall be schedulable, respond to a command from the electrical provider, and have a button for instant activation.

The user shall have the following configuration within each configurable level:

- Setpoint Relaxation
- Outside Air Shutdown
- Equipment Shutdown
- Chiller Plant State Limit
- Chiller Shutdown

Setpoint Relaxation will allow the setpoints to shift away from their current setpoint based on the amount specified in the active demand response level.

Outside Air Shutdown will deactivate the outside air equipment.

Equipment Shutdown will shut down the HVAC equipment.

Chiller Plant State Limit will limit the number of available states the chiller plant can use. A plant state of 0 will shut down the chiller plant.

Chiller Shutdown will shut down the chillers but allow the pumps to run maintaining differential pressure setpoint.

All equipment shall be configurable to ignore any or all demand response commands. The user shall have the ability to run a report to adjust each of these parameters.

The Demand Response dashboard shall display all levels and their configuration, the electrical demand of the facility, the current level of reduction scheduled, the button to enable each level, and the average reduction each level is able to achieve.

18. OPTIMAL STOP

The BAS shall initiate an Optimal Stop algorithm as the end of the schedule time period approaches. The optimal stop algorithm shall utilize the reduction in outside air, plant request, and setpoint relaxation. Outside air shutdown shall have a maximum shut-off time of 60 minutes (adjustable) prior to the end of time period. Plant request shutdown shall have a maximum shut-off time of 10 minutes (adjustable) prior to the end of time period. Setpoint relaxation shall have a maximum limit of 3°F over 45 minutes (adjustable).

One hour prior to end of schedule, the outside air shall shutdown and the setpoint relaxation shall reset 1°F (adjustable) every 15 minutes (adjustable). The equipment shall monitor the rate of change in the zones to determine when the plant request can be eliminated to finish the day without an impact to the zone temperatures.

19. EXTERIOR LIGHTING CONTROL

Equipment Control Points

Lighting contactor enable/disable - DO
Lighting controllers

The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator. Provide a photocell for monitoring by the BAS. Exterior lighting shall be turned off if the photocell senses light levels above a pre-determined limit.

Contractor shall program to allow the operator to select whether the system utilizes a boundary schedule and sunrise/sunset calculations. If the exterior lights are scheduled to operate, the operator shall have the option to select to enable them for an adjustable time period before or after sunset and disable for and adjustable time period before or after sunrise.

20. ELECTRIC UNIT HEATERS

Electric unit heaters shall be controlled by a factory furnished thermostat. BAS contractor shall install and wire thermostat.

21. SUPPLY FANS

Equipment Control Points

Space temperature - AI

Fan status – DI

Fan start/stop - DO

The BAS shall start/stop the supply fans to maintain a space temperature of 80°F (adjustable) during occupied schedule. The BAS shall monitor status of each fan.

NEW CTE ADDITION:

1. CHILLED WATER SYSTEM – PRIMARY / SECONDARY PUMPING (ACCH-05 & ACCH-06)

Central plant consists of two equal sized air-cooled chillers with dedicated primary chilled water pumps and secondary chilled water pumps for primary/secondary pumping system; refer to mechanical piping plans. **Each chiller shall be provided with a BACnet interface for read and write capability; BAS subcontractor to run communication wiring to each chiller.**

Equipment Control Points:

Plant CHW supply temperature - AI
Plant CHW return temperature - AI
Plant CHW flow - AI
Building CHW differential pressure - AI
Decouple Loop temperature - AI
Decouple Loop Flow - AI
Chiller amps/status, each chiller -AI
Chiller CHW supply temperature, each chiller - AI
Chiller CHW return temperature, each chiller - AI
Chiller Panel Output contacts, each chiller - AI
Chiller alarm, each chiller - DI
PCHP pump status, each pump - DI
SCHP pump status, each pump - DI
Chiller start/stop, each chiller - DO
SCHP pump start/stop, each pump - DO
CHP pump start/stop, each pump - DO
SCHP pump speed control - AO (each pump)

Chilled Water System Activation

The chilled water system shall be activated by a request for cooling from any unit it supplies with chilled water. The number of cooling requests required and the length of time the requests must be received before activating the plant shall be operator adjustable. The chilled water system shall be disabled if the outside air temperature is less than 45°F (operator adjustable).

Chiller Activation

When a chiller is activated, the BAS shall send a start command to the lead chillers controller. The BAS shall wire the primary pump aux. output contacts from the main chiller controller as inputs into the BAS controller. Upon receiving an input to start the pumps from the chiller controller, the BAS shall send the start command to the associated dedicated CHW primary pump starters. If the chiller alarm input closes (indicating that the chiller has alarm), the BAS shall generate an alarm at the central site computer, discontinue the start signal to the chiller and energize the next chiller in sequence to run in the same manner as described above.

Chiller Sequencing

A current sensor at each chiller shall monitor the amperage of each chiller. The BAS shall also receive temperature inputs from sensors mounted in the building's common supply and return piping. If the enabled chiller or chillers current load monitor indicates that the chiller or chillers are operating above 95% capacity and the building supply water temperature rises greater than 3°F (adjustable) above set point for five (5) minutes (adjustable) the next chiller in sequence shall be enabled into operation by the above-described sequence.

With more than one chiller operating, if the combined load decreases to 80% (adjustable) capacity of one less chiller for ten (10) minutes (adjustable) and the building supply water temperature is less than 3°F (adjustable) above set point, a chiller shall be de-energized.

The equal size chillers ACCH-05 and ACCH-06 shall be lead-lag alternated weekly by the BAS based upon cumulative runtime.

Secondary Chilled Water Pump Control

The secondary pumps shall be requested to run from the equipment being served. When the chilled water system is active, the lead secondary chilled water pumps (SCHP) shall be enabled. When the SCHP is commanded to run a current switch shall prove status to the BAS, which shall alarm at the central site if the switch is not made within 20 seconds (adjustable). If the lead pump indicates a bad status alarm the BAS shall discontinue the start signal to the lead SCHP and energize the lag SCHP to run. The lag SCHP now becomes the lead SCHP. The SCHP's shall be lead-lag alternated weekly at an operator adjustable time and day of the week by the BAS based upon accumulative runtime.

A differential pressure sensor across the building chilled water supply and return lines for secondary system shall monitor building differential pressure across the mains. The BAS shall modulate the speed of the operating secondary chilled water pump to maintain the building chilled water differential pressure at setpoint (adjustable). If the lead SCHP is operating at greater than 90% (adjustable) and the building differential pressure is greater than 3 psi (adjustable) below setpoint for 5 minutes (adjustable) the lag SCHP shall be started in tandem with the lead pump. The lag pump shall run until both pumps are operating at less than 30 % (adjustable) for 5 minutes (adjustable) at which time the lag pump shall be disabled.

The BAS shall monitor the position of all of the chilled water valves of the units that each secondary pump set serves and the differential pressure setpoint shall be reset based on achieving a target valve position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The chilled water flow shall not change by more than 10 percent per minute. The target valve position, the reset time, the dead band, and the rate of change values shall be operator adjustable. The equal size chillers shall be lead-lag and alternated weekly by the BAS based upon accumulative runtime.

Chilled Water Temperature Control

The chiller's internal controls shall maintain its chilled water supply temperature set point of 42°F (locally adjustable).

Freeze Protection

When the outdoor air temperature drops to 35°F (adjustable) or below, the BAS shall open the chilled water valves for flow through the coils for freeze protection and the primary & secondary chilled water pump system shall be activated to run until the low ambient temperature ceases to exist.

2. HEATING WATER SYSTEM (B-03 & B-04)

The heating water system is a fully condensing boiler hot water system with primary/secondary pumps and condensing boiler. The boiler system shall be controlled by a sequencing panel provided by the boiler manufacturer equipped with a BACnet interface card for the boiler. The BAS contractor shall provide a BACnet interface to the boiler to communicate with the sequencing panel to request the heating water system and monitor pertinent data from the boilers such as but not limited to leaving water temperature, status, alarm, etc.

The controls contractor shall provide capability for S/S for the boiler in order for end-user to start the boiler if master boiler controller or BACnet interface is down.

BAS shall provide low voltage control wiring and conduits connecting the boilers and for the end devices. BAS to provide conduit and communication wire between boilers.

Equipment Control Points:

Building HW supply temperature – AI
Building HW return temperature – AI
Building HW Return Flow Meter - AI
Boiler supply temperature – AI (each Boiler)
Hot Water differential Pressure – AI
Boiler status – DI (each Boiler)
Boiler alarm – DI (each Boiler)
HW Pump status (each pump) – DI
CO Monitoring - DI
Boiler Plant enable – DO
HW pump start/stop (each pump) – DO
HW Pump speed control (each pump) – AO
Boiler reset – AO
Boiler Room Space Temperature – AI
Boiler Room Supply Fan Start/Stop -Hardwired to damper end switch
Boiler Room Supply Fan Status – DI
Boiler Room Supply Fan Damper w/End switch– DO/HW 24v to fan S/S
Boiler Room Exhaust Fan Start/Stop – DO
Boiler Room Exhaust Fan Status – DI
Boiler Room Exhaust Fan Damper w/End switch– DO/HW 24v to Fan S/S

Heating Water System Activation

The heating water pump shall be activated by a request for heating from any equipment it supplies with heating water. A current switch shall prove status to the BAS and shall alarm at the central site if the contacts are not made within 20 seconds (adjustable). Once the heating water pump has proven positive flow, the BAS shall request the boiler system to run.

If the hot water supply temperature is less than 95°F (adjustable) or the building hot water pump status is not indicating the building hot water pump is running, the BAS control module shall broadcast that hot water is not available.

HW System is to include a stand-by pump which will be commanded on if the BAS commands the lead primary pump, and the pump status does not prove for more than 30 seconds (adjustable).
HW Pumps shall be rotated weekly to maintain equal runtime.

The BAS shall enable the system. The boiler sequencer decides who is lead and brings on the lag. The boiler controller also auto rotates if an alarm on the lead boiler is indicated.

Differential Pressure Control

A differential pressure sensor across the building heating water supply and return lines (located 2/3 down longest pipe run) shall monitor building differential pressure across the mains. The BAS shall modulate the speed of the lead heating water pump to maintain the building heating water differential pressure at setpoint (adjustable - final setpoint determined by TAB contractor).

The BAS shall monitor the position of all of the heating water valves and the differential pressure setpoint shall be reset based on achieving a target valve position of 90%. There shall be a dead band of 5% to prevent hunting of the reset program. The heating water flow shall not change by more than 10 percent per minute. The target valve position, the reset time, the dead band, and the rate of change values shall be operator adjustable.

Standby secondary HW Pump shall be rotated weekly to maintain equal runtime.

Heating Water Temperature Reset: The heating water shall have a ratio

Reset based on outside air temperature and the following schedule:

Outside Air Temp	Less than 50°F	Hot Water Temp	140°F
Outside Air Temp	Greater than 70°F	Hot Water Temp	100°F

Carbon Monoxide Monitoring

A carbon monoxide sensor installed in the boiler room will alarm the BAS and shutdown the boiler. The BAS shall notify district maintenance personnel via e-mail and text message when the level of carbon monoxide rises above 100 ppm (adjustable). The sensor shall also alarm the BAS and shutdown the boiler upon loss of power to the sensor. Boiler Room supply fan will be de-energized, and the emergency boiler room exhaust fan will be energized to dilute the carbon monoxide levels in the room. A strobe light and audible alarm at the panel will be activated during an event. A pushbutton on the panel will silence the alarm and reset the system. Carbon monoxide sensor shall be calibrated every eighteen months and a record of calibration shall be posted in a conspicuous place.

Refer to specification section 23 09 23.18 for CO detection requirements.

Freeze Protection

When the outdoor air temperature drops to 34°F (adjustable) or below, the BAS shall open the hot water valves for flow through the coils for freeze protection. The hot water system shall be activated to run and the building HW supply set point shall be set to 100°F (adjustable) while running the boiler only until the low ambient temperature ceases to exist, or the building start-up time arrives.

Boiler Room Supply Fan

The BAS shall start/stop the supply fan to maintain a space temperature of 80°F (adjustable) during occupied and unoccupied modes.

3. SERIES FAN POWERED AIR TERMINAL UNIT (CVB) – WITH HOT WATER HEAT

Equipment Control Points

Space temperature – AI
Discharge temperature - AI
Cold deck flow – AI
Fan Start/stop – DO
Cooling damper – FM
Re-heat valve – AO
CO2 Sensors – AI
Fan Status – DI

Zone Occupancy

The parent AHU shall have an occupancy schedule assigned to it. Upon occupancy the AHU shall broadcast an occupancy signal to the terminal unit,

When the CVB Boxes calculated start, time arrives its internal fan motor shall be energized and continue to run until the unoccupied period arrives.

CO2 Readings

The CO2 levels shall be measured in the spaces and broadcast to the applicable parent AHU. See AHU sequences for Demand Control Ventilation control.

Temperature Control

When the zone becomes active, the CVB controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall be modulated open to its operator adjustable maximum cooling CFM setpoint and cool request shall be

sent to the air handling unit serving the CVB. As the space temperature returns to setpoint, the CVB cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint.

The cooling damper actuator shall use a stepper motor so its position can be accurately tracked for display on the CVB graphic and collected by the air-handling unit serving the CVB to reset the air handling unit static pressure setpoint.

If heating is required, a run request will be sent to the heating water system (See Hot Water Sequence of Operation). The CVB terminal damper will be maintained at its adjustable minimum heating CFM setpoint, and the hot water reheat valve will be modulated (0-10v) to maintain the space temperature.

Unoccupied Control

During the unoccupied time period, the CVB cooling damper shall be open (operator adjustable) and its fan shall be de-energized. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F heating and 95°F cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

4. SINGLE DUCT VAV AIR HANDLING UNITS WITH DEMAND CONTROL VENTILATION (AHU-A-01, AHU-A-02, AHU-B-01, AHU-B-02 & AHU-B-03)

Equipment Control Points

Supply air temperature – AI
Discharge air temperature (each coil) – AI
Supply air duct static pressure – AI
Fan status – DI
High Static pressure limit – DI
Fan start/stop – DO
Fan speed control – AO
Chilled water valve control - AO
OA damper control – AO

AHU Activation

Each Single Duct variable air volume air handler shall be activated by a time-of-day schedule and shall broadcast an occupancy command to the associated terminal units.

Fan Control

When the air handler is scheduled to run, the B.A.S. controller will send signal to the air handler inverter, which will energize the fan. A current switch will prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. A run request will be sent to the Chilled Water System when the air-handling unit is active, and cooling is required.

Cold Deck Temperature Control

When the air handling unit is in occupied mode and cooling is required, the BAS shall send a request for cooling to the chiller plant and shall modulate the chilled water control valve to maintain leaving air temperature setpoint (55 °F, adjustable). The BAS shall have the ability to reset the leaving air temperature based on cooling request. When there are no cooling requests, the leaving air temperature setpoint shall reset up to a maximum of 58 °F (adjustable). When 2 (adjustable) or more cooling requests are present, the leaving air temperature setpoint shall reset down to 52 °F (adjustable). The reset shall not exceed more than 0.2 °F (adjustable) every 3 minutes (adjustable).

Air Volume Control

While the air handling unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable, final setpoint to be determined by TAB contractor) by modulating the speed of the supply

fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply duct. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the air handling unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.

The static pressure shall reset to achieve a target damper setpoint of 85% with a 5% dead-band. Static pressure shall reset by not more than 0.2" W.C. every 3 minutes. Static pressure shall be a minimum of 0.5" W.C.

Demand Control Ventilation

When the air handler is running in the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the OAHU that supplies the unit with outside air. A CO₂ sensor mounted in various spaces (see series fan powered box sequence) shall monitor the CO₂ level in the spaces. The B.A.S. shall select the highest level or average (user adjustable from settings page) to modulate the OA damper. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO₂ level at between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined with the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM.

The outside air damper shall remain closed, and the OAHU shall remain off even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Unoccupied Control

The AHU shall monitor the space temperature sensors and give the ability to select the high/low or average of the accumulation. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

Associated Equipment

During the occupied time period, a request to run shall be sent to the corresponding exhaust fans and OAHU. The exhaust fans associated with the air handler shall be energized only during the occupied time period. The OAHU's & exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on an outdoor air shutdown schedule.

Equipment off Conditions

When the air handling unit is de-energized, the cooling valve shall be closed, the outside air damper shall be closed, and any associated exhaust fans and OAHUs shall be de-energized.

5. SINGLE ZONE VAV AIR HANDLING UNITS WITH HUMIDITY CONTROL AND DEMAND CONTROL VENTILATION (AHU-A-03, AHU-A-04, AHU-A-05 & AHU-A-06)

Equipment Control Points

Space Sensors – AI (Combo Temp, Humidity & CO₂)
Discharge Air Temperature – AI
Cooling Coil Discharge Air Temperature – AI
Reheat HW Coil Discharge Air Temperature - AI
CO₂ Level(s) – AI
Fan Status – DI
Filter Status – DI
Air Handling Unit Fan start/stop – DO

Fan Speed Control – AO
Chilled Water Valve Control – AO
Hot Water Re-Heat Valve Control - AO
OA Damper Control – AO

AHU Activation

The air-handling unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The air-handling unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control

When the air handler is requested to run, the B.A.S. control module shall send an enable signal to the air handler inverter, which will energize the fan. A current switch shall prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms. A run request shall be sent to the Chilled Water System when the air-handling unit is active, and cooling is required. A run request shall be sent to the Heating Water System when the air-handling unit is active, and heating is required. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Temperature Control

A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the chilled water and heating water control valve actuators in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Outside Air Control (Demand Control Ventilation)

When the air handler is running in the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the OAHU that supplies the unit with outside air. A CO₂ sensor mounted in various spaces as indicated on drawings, shall monitor the CO₂ level (see series fan powered box sequence). The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO₂ level between 850 ppm and 1,000 ppm (all adjustable). If the CO₂ level rises above 1,200 ppm an alarm shall be sent to the central site. OA dampers minimum and maximum positions shall be determined by the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM. The B.A.S. shall select the highest level when more than one CO₂ sensor is used to modulate the damper. The system shall have the ability to perform a "Purge Mode" at a scheduled time for a scheduled duration.

The outside air damper shall remain closed, and the OAHU shall remain off even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule. The dedicated OAHU will modulate fan speed to maintain duct static pressure.

Outside Air Volume Control (AHU-A-04)

The BAS shall increase and decrease the outside airflow of the unit based on the number of exhaust devices in operation as follows:

All Hoods OFF: Outside Airflow = Demand Control Ventilation Sequence

KEF-01 Hood ON: Outside Airflow = 4,100 cfm

KEF-02 Hood ON: Outside Airflow = 900 cfm

KEF-03 Hood ON: Outside Airflow = 800 cfm

KEF-01 & KEF-02 Hoods ON: Outside Airflow = 5,000 cfm

KEF-02 & KEF-03 Hoods ON: Outside Airflow = 1,700 cfm

All Hoods ON: Outside Airflow = 5,770 cfm

Space Humidity Control

A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55°F (adjustable) and modulate the chilled water valve to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the hot water reheat valve to maintain the space temperature between its heating and cooling setpoints. If the B.A.S. control module is receiving a broadcast from the HW system that heating water is not available (see Heating Water System sequence of operations) the chilled water valve shall not be overridden until heating water is available. The fan will run at a fixed speed (determined by the TAB contractor) while in dehumidification mode.

Unoccupied Control

If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

If the space humidity reaches the operator adjustable unoccupied setpoints of 60% (adjustable), the required equipment shall be started and run to maintain the space humidity within the setpoints. All values are operator adjustable.

Humidity setpoints supersedes the temperature setpoints. The BAS shall initiate an alarm if temperature or humidity rises above unoccupied setpoint.

Associated Equipment

During the occupied time period, the outside air damper shall be open. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The outside air dampers shall remain closed, the exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule. The Exhaust fans shall be commanded (off) during morning cool down / warm up and shall only turn on during the occupied time periods. General exhaust fans may require a separate schedule to accomplish this sequence and will be part of the commissioning sequence of operations to be demonstrated.

An airflow switch shall monitor the pressure across the air filter. A contact closure from the air filter switch will alarm and notify maintenance through the B.A.S. of a dirty filter.

Equipment off Conditions

When the air-handling unit is de-energized, its chilled water valve, hot water valve and OA damper shall be closed. The related exhaust fans shall be de-energized and the request to run to the OAHU shall be canceled.

Freeze Protection

While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the primary & secondary pumps shall run for freeze protection.

6. VARIABLE AIR VOLUME 100% OUTSIDE AIR HANDLING UNITS (OAHU-A-01, OAHU-A-02 & OAHU-B-01)

Equipment Control Points

Discharge air temperature – AI
Discharge CHW coil air temperature – AI
Preheat HW coil air temperature – AI
Duct Static Pressure - AI
Air handling unit fan status – current switch - DI
Freeze stat – DI
CHW valve control - AO
HW pre-heat valve control - AO
Fan speed control – AO
Outdoor air damper – DO
Damper End Switch – DI
Outdoor air handling unit start/stop – DO
Static pressure high limit – DI (and hardwire interlock)

Unit Activation

When the outdoor air handling unit is requested to run by an air handler it serves, the Building Automation System (B.A.S.) shall first open the outside air damper and the actuator's internal end switch will close when the damper is open allowing the outdoor air unit to be started. The B.A.S. shall send a signal to the outdoor air handling unit inverter, which will start the fan. A current switch shall prove status to the B.A.S. and shall alarm at the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. The outdoor air damper shall be fully open before the outdoor air handling unit fan can be energized in either the hand or auto position.

Temperature Control

When the outdoor air handling unit is active, and heating is required a duct temperature sensor mounted downstream of the pre-heat coil will modulate the pre-heat valve to maintain the operator adjustable pre-heat discharge air temperature set point of 55°F (adjustable). If cooling is required a duct temperature sensor mounted in the unit's supply air stream shall monitor the unit's supply air temperature and modulate the chilled water valve to maintain the operator adjustable discharge air temperature set point. The operator shall be able to select if the supply air cooling set point shall be reset based on the outside air temperature or use an operator adjustable set point of 55°F. The outside air temperature reset schedule shall be a linear reset schedule with initial setpoints of 58°F supply air at 60°F outside air temperature and 55°F supply air at 75°F. The pre-heat control shall be disabled if the outside air temperature is greater than 55°F and the supply air cooling control shall be disabled if the outside air temperature is less than 53°F. All of the values shall be operator adjustable.

Air Volume Control

The B.A.S. control module shall monitor the fan status and OA damper position of the AHU's that the OAHU serves. The TAB contractor shall balance the system to meet scheduled outside air CFM for each AHU and determine the OAHU's required duct static pressure to supply each AHU's scheduled OA CFM. The B.A.S. shall send a signal to the variable speed drive, which will adjust the fan speed to maintain the static pressure setpoint determined by the TAB contractor.

The static pressure shall reset to achieve a target damper setpoint of 85% with a 5% dead-band. Static pressure shall reset by not more than 0.2" W.C. every 3 minutes. Static pressure shall be a minimum of 0.5" W.C.

Freeze Protection

A manual reset freeze stat mounted in the discharge air stream of the pre-heating coil shall open the HW control valves to 30% and CHW control valves to 50% (adjustable), close the outside air damper, de-energize the outside air handling unit fan, energize a secondary chilled water pump, a secondary hot water pump and boilers (see heating water sequence of operation), and alarm at the central site if

the leaving air temperature drops to 34°F (locally adjustable). The freeze stat must be manually reset once the temperature rises above the trip point.

Equipment off Conditions

When the outdoor air-handling unit is off, it's chilled and heating water valves shall be closed, and the outdoor air damper shall also be closed. If the outside air temperature drops below 34°F (operator adjustable), the B.A.S. shall open hot water valve to 30% and chilled water valves to 50% (adjustable).

7. HYDRONIC FAN COIL UNITS WITH RE-HEAT COIL (FCU-A-01 & FCU-B-02)

Equipment Control Points

Space Sensors – AI (Combo Temp & Humidity)
Discharge air temperature – AI
Fan status – DI
Chilled water valve – AO
Re-heat valve – AO
Fan start/stop – DO
Outdoor air damper – DO
Float Switch – DI (Suspended Ducted Units Only)

Zone Occupancy

Each unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature versus the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site.

Fan Control

When the calculated start time arrives, the BAS shall energize the fan. A current switch shall prove status to the BAS and shall alarm at the central site if the switch is not made within 40 seconds (adjustable).

Space Temperature Control

A temperature sensor shall monitor the air temperature in the space. The BAS shall modulate the chilled water and hot water control valve, in sequence, to maintain the space temperature within setpoint.

Space Humidity Control

A humidity sensor shall monitor the humidity in the space. When there is a call for dehumidification, the BAS shall open the chilled water valve to maintain a 55°F cold deck temperature and shall modulate the reheat valve to maintain the occupied cooling & heating setpoint. If heating is not available dehumidification mode shall be deactivated.

Outside Air

When the unit is in occupied mode, the BAS controller shall open the outside air damper.

Associated Equipment

During the occupied time period, any associated exhaust fans shall be energized.

Unoccupied Control

During the unoccupied time period, if the space temperature reaches the unoccupied heating or cooling setpoints (55°F heating and 95°F cooling, adjustable) the required equipment shall be started and run as normal to maintain the space temperature within these setpoints.

Equipment Off Conditions

When the unit is off, the chilled water and hot water valves shall be closed, the outside air damper shall be closed, and any associated exhaust fans shall be de-energized. A float switch shall monitor the moisture/water level in the drain pan. The unit shall shutdown when overflow is detected.

Freeze Protection

While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the primary / secondary pumps shall run for freeze protection.

8. HYDRONIC FAN COIL UNITS – COOLING ONLY (FCU-A-02 & FCU-B-01)

Equipment Control Points

Space Sensors – AI (Combo Temp & Humidity)
Discharge air temperature – AI
Fan status – DI
Chilled water valve – AO
Re-heat valve – AO
Fan start/stop – DO
Float Switch – DI (Suspended Ducted Units Only)

Zone Occupancy

Each unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature versus the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site.

Fan Control

When the calculated start time arrives, the BAS shall energize the fan. A current switch shall prove status to the BAS and shall alarm at the central site if the switch is not made within 40 seconds (adjustable).

Space Temperature Control

A temperature sensor shall monitor the air temperature in the space. The BAS shall modulate the chilled water and hot water control valve, in sequence, to maintain the space temperature within setpoint.

Unoccupied Control

During the unoccupied time period, if the space temperature reaches the unoccupied heating or cooling setpoints (55°F heating and 95°F cooling, adjustable) the required equipment shall be started and run as normal to maintain the space temperature within these setpoints.

Equipment Off Conditions

When the unit is off, the chilled water and hot water valves shall be closed, the outside air damper shall be closed, and any associated exhaust fans shall be de-energized. A float switch shall monitor the moisture/water level in the drain pan. The unit shall shutdown when overflow is detected.

Freeze Protection

While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the primary / secondary pumps shall run for freeze protection.

**9. KITCHEN HOOD EXHAUST FANS / 100% CHILLED & HEATING WATER OUTSIDE AIR MAKE-UP AIR UNIT
(KEF/MAU-01 & KEF/MAU-02)**

Exhaust Fan Equipment Control Points

Exhaust fan status (each fan) - Current switch – DI
Exhaust fan enable – DO
Hood Status – DI

Make-Up Air Unit Equipment Control Points

Discharge air temperature – AI
Discharge CHW coil air temperature – AI
Preheat HW coil air temperature – AI
Reheat HW coil air temperature – AI
Duct Static Pressure - AI
Air handling unit fan status – current switch - DI
Freeze stat – DI
CHW valve control - AO
HW pre-heat valve control – AO
HW re-heat valve control - AO
Fan speed control – AO
Outdoor air damper – DO
Damper End Switch – DI
Outdoor air handling unit start/stop – DO
Static pressure high limit – DI (and hardwire interlock)

The kitchen hood supply MAU and exhaust fans shall be interlocked to operate together. The hood fans shall be enabled to run by the BAS based on an operator assigned schedule. When the fans are enabled to run, they shall be controlled via a local switch mounted at the hood. Status of each hood will be monitored by the BAS. If exhaust hood is switched on, its associated exhaust fan shall turn on and makeup air damper shall open. Once open as determined by end-switch, the makeup air unit will be enabled.

The outside air temperature and relative humidity sensors shall control the MAU mode of operation. When the outside air temperature is above 55°F, the BAS shall set the cooling coil discharge air setpoint to 55°F (adjustable) and modulate the hot water re-heat valve to maintain the discharge temperature set point of 68°F (adjustable).

When the outside air temperature is below 55°F, the BAS shall modulate the hot water pre-heat valve to maintain the discharge temperature set point of 68°F (adjustable).

Freeze Protection

A manual reset freeze stat mounted in the discharge air stream of the pre-heating coil shall open the HW control valves to 30% and CHW control valves to 50% (adjustable), close the outside air damper, de-energize the outside air handling unit fan, energize a secondary chilled water pump, a secondary hot water pump and boilers (see heating water sequence of operation), and alarm at the central site if the leaving air temperature drops to 34°F (locally adjustable). The freeze stat must be manually reset once the temperature rises above the trip point.

Equipment off Conditions

When the outdoor air-handling unit is off, it's chilled and heating water valves shall be closed, and the outdoor air damper shall also be closed. If the outside air temperature drops below 34°F (operator adjustable), the B.A.S. shall open hot water valve to 30% and chilled water valves to 50% (adjustable).

10. DISHWASHER EXHAUST

Equipment Control Points

Exhaust/Supply fan status (each fan) - Current switch – DI

Interlock exhaust fan to operate when dishwasher is operating. Provide off delay to allow fan to run for 10 minutes (field adjustable) after dishwasher has been de-energized.

11. DUCTLESS MINI-SPLIT-SYSTEM AIR CONDITIONERS

The split systems shall have a factory furnished controller and operate stand-alone based on unit thermostat. The BAS shall monitor the space temp only. Thermostat provided by unit manufacturer and installed by BAS.

Equipment Control Points

Space temperature – AI (monitoring only)

12. GENERAL EXHAUST FANS

Equipment Control Points

Exhaust fan status – DI

Exhaust fan enable – DO

Motorized Damper – DO (where indicated on drawings)

Interlock all general exhaust fans to run with air handling equipment serving the same area and run only during the occupied mode with their OA Dampers open. The exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button or based on a summer mode schedule. Where exhaust fans have associated motorized dampers (in-line exhaust fans), BAS contractor shall provide dampers and actuators and necessary interlock wiring to allow damper to open whenever the exhaust fan is running.

13. BOILER ROOM SUPPLY FAN

Equipment Control Points

Exhaust fan status – DI

Exhaust fan start/stop – DO

Interlock boiler to operate whenever heating water system is operating. BAS shall report an alarm if the fan fails to start.

14. OUTDOOR AIR CONDITIONS

Equipment Control Points

Outdoor air temperature – AI

Outdoor air humidity - AI

The sensors shall be mounted in an area on the north side of the building where the representative temperature and humidity can be monitored, both shall have sun shields. Based on the outside air temperature and humidity the BAS shall calculate the outdoor enthalpy, wet bulb, and dew point temperatures. The outdoor air temperature and humidity shall be broadcast as global information for use by the other control programs.

15. OUTSIDE AIR INTAKE HOODS

Equipment Control Points

Damper open/close – DO

When the associated Air Handling Unit is in occupied mode, the BAS controller shall open the outside air damper. Damper and actuators provided by Intake Hood manufacturer, wiring and installation by BAS.

16. BUILDING RELIEF HOODS

Equipment Control Points

Isolation damper OPEN / CLOSE - DO
Damper Position Status – DI

The BAS shall OPEN each motorized relief damper when the associated area is occupied. An internal Barometric damper shall OPEN/ CLOSE according to interior building air pressure.

Damper and actuators provided and installed by BAS.

In the event of a Shelter in Place shutdown all motorized Relief dampers shall be CLOSED.

17. COOL-DOWN CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the cool-down cycle shall be regulated by the BAS optimum start/stop routine. The cool-down cycle shall continue until all space temperatures are at or below the setpoint. Cool-down cycle shall not be initiated when outside air temperature is less than 80°F.

18. WARM-UP CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed, and the exhaust fans shall be OFF. The duration of the warm-up cycle shall be regulated by the BAS optimum start/stop routine. The warm-up cycle shall continue until all space temperatures are at or above the setpoint. Warm-up cycle shall not be initiated when outside air temperature is greater than 70°F.

19. LOAD SHEDDING

Provide load shedding capabilities via software. This should include setpoint relaxation, setpoint reset and shutdown of equipment. Coordinate equipment shutdown with the owner.

The user shall have the ability to have 8 levels of adjustment to reduce the electrical demand of the facility. Each level shall be schedulable, respond to a command from the electrical provider, and have a button for instant activation.

The user shall have the following configuration within each configurable level:

- Setpoint Relaxation
- Outside Air Shutdown
- Equipment Shutdown
- Chiller Plant State Limit
- Chiller Shutdown

Setpoint Relaxation will allow the setpoints to shift away from their current setpoint based on the amount specified in the active demand response level.

Outside Air Shutdown will deactivate the outside air equipment.

Equipment Shutdown will shut down the HVAC equipment.

Chiller Plant State Limit will limit the number of available states the chiller plant can use. A plant state of 0 will shut down the chiller plant.

Chiller Shutdown will shut down the chillers but allow the pumps to run maintaining differential pressure setpoint.

All equipment shall be configurable to ignore any or all demand response commands. The user shall have the ability to run a report to adjust each of these parameters.

The Demand Response dashboard shall display all levels and their configuration, the electrical demand of the facility, the current level of reduction scheduled, the button to enable each level, and the average reduction each level is able to achieve.

20. OPTIMAL STOP

The BAS shall initiate an Optimal Stop algorithm as the end of the schedule time period approaches. The optimal stop algorithm shall utilize the reduction in outside air, plant request, and setpoint relaxation. Outside air shutdown shall have a maximum shut-off time of 60 minutes (adjustable) prior to the end of time period. Plant request shutdown shall have a maximum shut-off time of 10 minutes (adjustable) prior to the end of time period. Setpoint relaxation shall have a maximum limit of 3°F over 45 minutes (adjustable).

One hour prior to end of schedule, the outside air shall shutdown and the setpoint relaxation shall reset 1°F (adjustable) every 15 minutes (adjustable). The equipment shall monitor the rate of change in the zones to determine when the plant request can be eliminated to finish the day without an impact to the zone temperatures.

21. EXTERIOR LIGHTING CONTROL

Equipment Control Points

Lighting contactor enable/disable - DO
Lighting controllers

The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator. Provide a photocell for monitoring by the BAS. Exterior lighting shall be turned off if the photocell senses light levels above a pre-determined limit.

Contractor shall program to allow the operator to select whether the system utilizes a boundary schedule and sunrise/sunset calculations. If the exterior lights are scheduled to operate, the operator shall have the option to select to enable them for an adjustable time period before or after sunset and disable for and adjustable time period before or after sunrise.

22. ELECTRIC UNIT HEATERS

Electric unit heaters shall be controlled by a factory furnished thermostat. BAS contractor shall install and wire thermostat.

23. SUPPLY FANS

Equipment Control Points

Space temperature - AI
Fan status - DI
Fan start/stop - DO

The BAS shall start/stop the supply fans to maintain a space temperature of 80°F (adjustable) during occupied schedule. The BAS shall monitor status of each fan.

24. FREEZER/COOLER TEMPERATURE MONITORING AND ALARM

Equipment Control Points

Cooler temperatures – AI

Freezer temperatures – AI

The BAS contractor shall provide temperature sensors in the freezers and coolers. The BAS shall monitor the freezer and cooler temperatures and indicate the temperatures at the operator station. The BAS shall initiate an alarm if temperature rises above design and be sent to the computers, pagers, text message / compatible cell phone designated by LCISD personnel. The BAS contractor shall set up trending information and reports per district standard. Coordinate with freezer/cooler manufacturer.

25. EMERGENCY BUILDING SHUTDOWN (SHELTER IN PLACE)

Equipment Control Points

Shutdown switch status – dry contact - DI

Provide a single mushroom style pushbutton adjacent to fire alarm control panel. Operation shall be pushbutton off, keyed switch on. Provide clear plastic cover to prevent accidental activation. Provide engraved identification tag with "Emergency HVAC Shutdown". When activated, the BAS shall shut down the HVAC system and close all intake, exhaust, and relief dampers. The button must be manually reset (via key) to allow the HVAC system to resume normal operation. Confirm location with owner/architect prior to installation.

26. DOMESTIC WATER HEATER

Equipment Control Points

CO Monitoring – DI

Carbon Monoxide Monitoring

A carbon monoxide space sensor will alarm the BAS and shutdown the domestic water heater and notify district maintenance personnel via e-mail and text message when the level of carbon monoxide rises above 100 ppm. The sensor shall also alarm the BAS and shutdown the water heater upon loss of power to the sensor. A strobe light and audible alarm at the panel will be activated during an event. A pushbutton on the panel will silence the alarm and reset the system. Carbon monoxide sensor shall be calibrated every eighteen months and a record of calibration shall be posted in a conspicuous place.

27. POWER MONITORING

Equipment Control Points

KW input – From Switchgear – BACnet Interface

The BAS shall connect to building electrical meter and monitor the buildings KWH usage. The B.A.S. control module shall show the current usage, monthly usage, year-to-date usage, and time and date of the highest peak demand for the month and year. Demand thresholds may be set to adjust set-points and shed loads in order to reduce peak consumption.

28. MISCELLANEOUS METERING / MONITORING

Building Water Metering

The main water meter entering the building shall be monitored for usage. Meters shall be provided by the BAS and installed by the plumbing contractor. The BAS shall record historical data to include current gallons, gallons today, previous day, for the month and previous month, the year and previous year.

Natural Gas

The main natural gas meter to the building will send a pulse signal to the BAS. Meters shall be provided by the BAS and installed by the plumbing contractor. The BAS shall record historical data to include current gas usage, CF/Today, CF previous day, CF for the month and CF for the previous month, CF for the year and CF for the previous year.

EXISTING AG BARN:

1. WELDING GENERAL EXHAUST

Equipment Control Points

Exhaust Fan Status – Current Switch – DI
Damper Open / Close – DO

BAS shall monitor the fan status. Fan shall be controlled by ON / OFF. Motorized dampers shall interlock to allow damper to open / close whenever the exhaust fan is ON / OFF.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot water heating piping.
 - 2. Chilled water piping.
 - 3. Make-up water piping.
 - 4. Condensate-drain piping.
 - 5. Blowdown drain piping.
 - 6. Air-vent piping.
- B. Related Sections include the following:
 - 1. Section 23 21 23 "Hydronic Pumps" for pumps, motors, and accessories for Hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

1.5 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.6 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.

2. RTRP and RTRF with adhesive.
3. Pressure-seal fittings.
- C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. The Pipe shop drawings shall be superimposed on the architectural backgrounds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control test reports.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.
- E. Test Reports: Indicate results of refrigerant leak test and acid test.
- F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.8 QUALITY ASSURANCE

- A. All pipe and accessories shall be of United States domestic manufacture.
- B. Installer Qualifications:
 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.

- G. Maintain one copy of each document on site.
- H. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- D. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- E. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. Housing: Ductile Iron.

2. Gasket: EPDM, Grade EHP
3. Pipe Sizes 2" and larger
4. Tools: Manufacturer's grooving tools.
5. Minimum 300-psig working-pressure rating at 250 deg F.

C. Copper or Bronze Pressure-Seal Fittings:

1. Housing: Copper.
2. O-Rings and Pipe Stops: EPDM.
3. Pipe Sizes 2" and down
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends; application as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 250.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings; ASTM F 439 for Schedule 80 pipe.
- C. PVC Plastic Pipe: ASTM D 1785, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- D. PVC Plastic Pipe Fittings: Socket-type pipe fitting; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBI.
2. CPVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBI.
 - d. NIBCO INC.
2. MSS SP-107, CPVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 150 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Description:
 - a. Non-conducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or Phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection.
 - b. Matco-Norca, Inc.
 - c. Precision Plumbing Products, Inc.
 - d. Victaulic Company.
 2. Description:
 - a. Standard: IAPMO PS 66
 - b. Electroplated steel nipple. Complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot water heating and chilled water, above ground, NPS 2 and smaller, shall be the following:
 - 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot water heating and chilled water above ground, NPS 2-1/2 and larger, shall be one of the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Makeup-water piping installed aboveground shall be the following:
 - 1. ASTM B 88, Type K (ASTM B 88M, Type B) drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- D. Condensate-Drain Piping: ASTM B 88, Type L (ASTM B 88M, Type B) hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blow-down drain is installed.
- F. Air-Vent Piping:
 - 1. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.

- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."
- U. Install lateral bracing with pipe hangers and supports to prevent swaying.
- V. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- X. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment".
- Y. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 – "Hangers and Supports for HVAC Piping and Equipment".
- Z. Provide access doors where valves and fittings are not accessible.
- AA. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- BB. Provide unions or flanges and isolation valves at each connection to a piece of equipment or control valve; accessory which requires removal for maintenance. Screwed unions should be used for two (2) inches IPS and smaller. Locate joints where they can be accessed for repair. Screw or flanged joints shall not be permitted above inaccessible ceilings or in chases.

- CC. All piping shall be installed to eliminate traps and pockets. Where air pockets or water trap cannot be avoided, provide means for drainage with valved hose connections for water trap and air vents for air pockets. Provide drain valves at low points of the system.
- DD. For pipe inside building, install parallel to lines of building, close to columns and walls vertical pipe shall be truly vertical. Spring or forcing piping into place will not be permitted. Install pipe to prevent strain on equipment connections.
- EE. Provide adequate access to all equipment, motorized valves, instruments, controls, and access panels.
- FF. Allow easy draining of water piping, with drain valves at low points.

3.3 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.4 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

3.5 FIELD QUALITY CONTROL

- A. Prepare Hydronic piping according to ASME B31.9 and as follows:
 1. Leave joints, including welds, un-insulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 3. Flush Hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on Hydronic piping:
 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that Hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least one hour, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of Hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 21 16 - UNDERGROUND HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Factory fabricated and pre-insulated Cased piping system and fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever joining dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment, or other apparatus.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Cased piping.
- B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops. Detail location of anchors, alignment guides, and expansion joints and loops. Show types, sizes, materials, and elevations of other utilities crossing hydronic piping.
 - 1. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable manufacturer style or series number.
 - 2. Calculate requirements for expansion compensation for underground piping.
 - 3. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads and show concrete thrust block dimensions.
 - 4. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Welding certificates.
- C. Material Test Reports: For cased piping.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. All pipe and accessories shall be of United States domestic manufacture.
- B. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- G. Maintain one copy of each document on site.
- H. All grooved joint piping products shall be supplied by a single domestic manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.
- I. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- D. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- E. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 CASED PIPING SYSTEM

- A. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perma-Pipe
 - b. Thermacor Process, Inc.
 - c. Insul-Pipe Systems
- B. Carrier Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends.

1. When practical, piping shall be provided in 40-foot double-random lengths. All carbon steel pipes shall have ends cut square and beveled for butt-welding. Straight sections of factory pre-insulated pipe shall have six (6) inches of exposed pipe at each end for field joint fabrication.
- C. Carrier Pipe Insulation:
 1. Polyurethane Foam Pipe Insulation: Rigid, cellular, high-pressure injected between carrier pipe and jacket.
 - a. Comply with ASTM C 591; thermal conductivity (k-value) shall not exceed 0.16 Btu x in. /h x sq. ft. x deg F at 75 deg F after 180 days of aging.
- D. Casing: Extruded, black, high density polyethylene (HDPE), wall thickness not less than 125 mils for pipe sizes less than or equal to 12 inches, 150 mils for jacket sizes greater than 12 inches. No FRP, HDUP, or tape jacket allowed.
- E. Casing accessories include the following:
 1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
 2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
 3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.
- F. Moisture barrier and seals: Factory applied, sealed to the jacket and carrier pipe. End seals shall be certified as having passed a 20-foot head pressure test. End seals shall be high temperature mastic completely sealing the exposed end of the insulation.
- G. Straight joints shall be factory fabricated and pre-insulated, using polyurethane foamed poured in HDPE sleeve and sealed with a pressure sensitive polyethylene backed, 30 mils thick heat shrink wrap. All joint closures and insulation shall occur at straight sections of pipe. All insulation and jacketed materials shall be furnished and installed by pre-insulated pipe manufacturer. Field applied insulation piping shall not be acceptable.
- H. Fittings: Factory fabricated and pre-insulated with polyurethane foam to the thickness specified and jacketed with a one-piece seamless molded HDPE fitting cover, a butt fusion welded, or an extrusion welded and mitered HDPE jacket. Carrier pipe fittings shall be butt-welded, except sizes smaller than two (2) inches shall be socket-welded. Fittings shall be prefabricated / pre-engineered. Fittings include expansion loops, elbows, tees, reducers, and anchors. Elbows, loops, offset, or any other direction changes shall conform to the standards set by ANSI B3.1.1. Field applied insulated fittings shall not be acceptable.
- I. Expansion and Contraction: Compensation will be accomplished utilizing factory prefabricated and preinsulated expansion elbows, Z-bends, expansion loops and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pad (minimum one (1) inch thickness), extending on either side, both inside and outside the radius of the fittings are used with all fittings having expansion in excess of 1/2 inch.
- J. Manholes: Black steel with lifting eyes.
 1. Finish: Spray-applied urethane, minimum 30 mils thick.

2. Access: 30-inch diameter waterproof cover with gasket, ladder, and two 6-inch vents, one high and one low, extending above grade with rain caps.
 3. Conduit Stub-Outs and Seals: Welded steel with drain and vent openings.
 4. Sump: 12 inches in diameter, 12 inches deep.
 5. Floatation Anchor: Oversized bottom keyed into concrete base.
- K. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. See Division 31 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATION

- A. Hot water heating piping, chilled water piping, condenser water piping, underground, shall be the following:
1. Cased piping with polyurethane carrier-pipe insulation.
 - a. Piping Insulation Thickness: 1 inch.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Remove standing water in the bottom of trench.
- C. Do not backfill piping trench until field quality-control testing has been completed and results approved.
- D. Install piping at uniform grade of 0.2 percent. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points and elsewhere as required for system drainage. Install manual air vents at high points.
- E. Install components with pressure rating equal to or greater than system operating pressure.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. See Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for mechanical sleeve seals through exterior building walls.
- I. Secure anchors with concrete thrust blocks.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Brazed Joints: Construct joints according to AWS's "Braze Handbook," Ch. 35, "Pipe and Tubing," using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation and exterior jacket sleeve and apply shrink-wrap seals.

3.5 IDENTIFICATION

- A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic piping. Locate tapes 6 to 8 inches below finished grade, directly over piping.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Prepare hydronic piping for testing according to ASME B31.9 and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.

- c. Use vents installed at high points to release trapped air while filling system.
- 2. Test hydronic piping as follows:
 - a. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure.
 - b. After hydrostatic test pressure has been applied for a minimum of (1) one hour, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.
- D. Prepare test and inspection reports.

END OF SECTION 23 21 16

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line circulators
 - 2. Split-Coupled Vertical In-line pumps
 - 3. Automatic Condensate Pump Units
- B. Related Sections:
 - 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment - Mechanical Vibration Control: Product requirements for vibration isolators required with pumps.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide pumps electrical characteristics in accordance with Division 26 and schedules on Drawings.

1.5 SUBMITTALS

- A. Submit in accordance with Division 1 and Section 23 05 00.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Provide parallel pump curves indicating the non-overloaded motor horsepower for single pump operation when applicable. Include NPSH curve with operating point plotted when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- D. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

- E. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1, General Requirements.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.7 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for pumps. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Furnish one (1) set of mechanical seals for each pump installed.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Pumps shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect

the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 PUMP IDENTIFICATION REQUIREMENTS

- A. Furnish each pump with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - Flow rate (GPM) and head (ft. H2O).
 - Motor Horsepower.
 - RPM
 - Power Supply: Volts / PH / Amps.
 - Sales Order #.
 - Date of unit manufactured.
- B. For chilled water pumps, in addition to the base mounted identification tag provide an additional identification tag shipped loose for contractor to install on external rigid insulation board.

PART 2 – PRODUCTS

2.1 IN-LINE CIRCULATORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Pentair / Aurora.
 2. Armstrong.
 3. Bell & Gossett.
 4. Armstrong.
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed to shaft.
- E. Bearings: Two, oil lubricated bronze sleeves.
- F. Shaft: Stainless steel with copper or bronze sleeve, integral thrust collar.
- G. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Flexible coupling.
- I. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.2 "SPLIT-COUPLED" VERTICAL IN-LINE PUMPS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 1. Pentair / Aurora
 2. Armstrong.
 3. Bell & Gossett.
 4. Armstrong.
- B. Type: Vertical shaft, single stage, direct connected, radial split casing, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connections with factory installed seal flush line, recessed cast iron drain pan with threaded connection for field piping to drain, flanged suction and discharge.
- D. Impeller: 316 stainless steel, fully enclosed, dynamically balanced, and keyed to shaft.
- E. Bearings: Grease or permanently lubricated roller or ball bearings. Bearings shall have 40,000-hour minimum life.
- F. Shaft: 416 stainless steel with stainless steel shaft sleeve.
- G. Mechanical Seals: Stainless steel multi-spring outside balanced type with a Viton secondary seal, carbon rotating face and Silicon Carbide stationary seat. Provide 316 stainless steel gland plate with factory installed flush line with manual vent, 225 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Axially split, spacer type rigid coupling constructed of high tensile aluminum bar with OSHA approved coupling guard.
- I. Motor: Single speed and rigidly mounted to pump casing.
 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - a. Enclosure: Outdoors: Totally enclosed, fan cooled (TEFC).
 - b. Enclosure: Indoors: Open Drip Proof (ODP).
 - c. Efficiency: Premium efficient.
 - d. NEMA Design: MG-1.
 - e. Service Factor: 1.15.

2.3 AUTOMATIC CONDENSATE PUMP UNITS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Beckett Corporation
 - 2. Hartell Pumps
 - 3. Little Giant Pump Co.
 - 4. Mepco, LLC.
- B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory or field-installed check valve and a 72-inch minimum, electrical power cord with plug.

2.4 PUMP SUCTION DIFFUSERS

- A. Not applicable – shall be part of pump isolation drop, coordinate with Victaulic. Coordinate suction diffuser size with Victaulic for seamless connection. Refer to 23 05 23; 2.2 for further information.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide no less than the minimum as required by the manufacturer.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping
- D. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- E. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Provide drains for bases and seals. Route to floor drain.
- H. Lubricate pumps before start-up according to manufacturer's instructions.

3.3 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Discharge side of pumps install Victaulic Vic-300 non-slam check valve, Victaulic Vic-300 combination shut-off butterfly valve and throttling valve with memory stop.
- F. Suction side of pumps install Victaulic Series 731 suction diffuser with type 304 stainless steel strainer and Victaulic Vic-300 shut-off butterfly valve on suction side of pumps.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping or install single gage with multiple-input selector valve.

3.4 STARTUP SERVICE

- A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 - a. Check piping connections for tightness.
 - b. Clean strainers on suction piping.
 - c. Perform the following startup checks for each pump before starting:
 1. Verify bearing lubrication.
 2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If

pump is bound or drags, do not operate until cause of trouble is determined and corrected.

3. Verify that pump is rotating in the correct direction.
 - d. Prime pump by opening suction valves and closing drains and prepare pump for operation.
 - e. Start motor.
 - f. Open discharge valve slowly.

3.5 DEMONSTRATION

- A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.
 1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.
 2. Provide documentation of owner training in close out submittal.

END OF SECTION 23 21 23

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Refrigerant piping.
2. Refrigerant Insulation.
3. Unions, flanges, and couplings.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant strainers.
7. Refrigerant pressure regulators.
8. Refrigerant pressure relief valves.
9. Refrigerant filter-driers.
10. Refrigerant solenoid valves.
11. Refrigerant expansion valves.
12. Electronic expansion valves.
13. Refrigerant receivers.

- B. Related Sections:

1. Section 31 00 00 - Earthwork: Earthwork for backfill in trenches.
2. Section 31 23 16.13 – Trenching and Backfilling: Execution requirements for trenching and backfilling required by this section.
3. Section 07 84 00 - Firestopping: and Fire Safing Product requirements for firestopping for placement by this section.
4. Section 08 31 13 - Access Doors: Access doors for concealed valves and accessories.
5. Section 09 91 00 - Painting and Staining: Product requirements for painting for placement by this section.

6. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and sleeves for placement by this section.
7. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.
8. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
9. Section 23 07 19 - HVAC Piping Insulation: Product requirements for Piping Insulation for placement by this section.
10. Section 23 21 13 - Hydronic Piping: Piping materials for refrigerant systems.

1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 1. ARI 495 - Refrigerant Liquid Receivers.
 2. ARI 710 - Liquid-Line Driers.
 3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
 4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
 5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. American Society of Mechanical Engineers:
 1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 3. ASME B31.5 - Refrigeration Piping.
 4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. ASTM International (ASTM):
 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 5. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- G. Underwriters Laboratories Inc.:
1. UL 429 - Electrically Operated Valves.

1.4 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-407C:
1. Suction Lines for Air-Conditioning Applications: 230 psig.
 2. Suction Lines for Heat-Pump Applications: 380 psig.
 3. Hot-Gas and Liquid Lines: 380 psig.
- B. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig.
 2. Suction Lines for Heat-Pump Applications: 535 psig.
 3. Hot-Gas and Liquid Lines: 535 psig.

1.5 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Provide receivers sized to accommodate pump down charge.
- E. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.6 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Submit in Accordance with Division 1 - General Requirements.
- C. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- D. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.
- E. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
 - a. Refrigerant moisture and liquid indicators.
 - b. Refrigerant strainers.
 - c. Refrigerant pressure regulators.
 - d. Refrigerant pressure relief valves.
 - e. Refrigerant filter-driers.
 - f. Refrigerant solenoid valves.
 - g. Refrigerant expansion valves.
 - h. Electronic expansion valves.
- F. Test Reports: Indicate results of piping system pressure test.
- G. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- H. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- I. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, equipment, and refrigerant accessories.
- B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.8 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1- General Requirements.
- B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- F. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- G. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 WARRANTY

- A. Furnish five (5) year manufacturer warranty for valves excluding packing.

1.12 MAINTENANCE MATERIALS

- A. Furnish two (2) refrigerant oil test kits each containing everything required for conducting one test.

1.13 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size and valve type.
- B. Furnish two (2) refrigerant filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B 280, Nitrogenized Type L - ACR hard drawn.
 - 1. Wrought-copper Fittings: ASME B16.22.
 - 2. Brazing Filler Metals: AWS A5.8. BCuP: minimum 15% silver (Ag), 5% phosphorous (P), and balance copper (Cu).
 - 3. Final product composition shall be 99% pure copper and lead free.
 - 4. Provide in 10 ft. and 20 ft. straight tube lengths.
 - 5. **Bendable pipe of any kind shall not be accepted.**

2.2 UNIONS, FLANGES, AND COUPLINGS

- A. Two (2) inches and Smaller:
 - 1. Copper Pipe: Bronze, soldered joints.
- B. 2-1/2 inches and Larger:
 - 1. Copper Piping: Bronze
 - 2. Gaskets: 1/16-inch-thick preformed neoprene.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 REFRIGERANT MOISTURE AND LIQUID INDICATORS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division

3. Sporlan Valve Co.

B. Indicators:

1. Port: Single, UL listed.
2. Body: Brass, solder ends.
3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 200 degrees Fahrenheit.

2.4 VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
3. Sporlan Valve Co.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
2. Phosphor bronze and stainless-steel diaphragms, rising stem and hand wheel.
3. Stainless steel spring, nylon seats, disc with positive back seating.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 275 degrees Fahrenheit.

C. Packed Angle Valves:

1. Forged brass, solder ends.
2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
3. Maximum working pressure: 500 psig
4. Maximum working temperature: 275 degrees Fahrenheit.

D. Ball Valves:

1. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
2. Maximum working pressure: 500 psig and

3. Maximum working temperature: 300 degrees Fahrenheit.
- E. Service Valves:
 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, solder ends.
 2. Maximum working pressure: 500 psig.
- F. Refrigerant Check Valves:
 1. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - a. Alco Controls Div, Emerson Electric Co.
 - b. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - c. Sporlan Valve Co.
 2. Globe Type:
 - a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless-steel spring, Teflon seat disc.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 300 degrees Fahrenheit.
 3. Straight Through Type:
 - a. Spring, neoprene seat.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 250 degrees Fahrenheit.

2.5 REFRIGERANT STRAINERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co. Model.
- B. Straight Line or Angle Line Type:
 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless-steel wire or monel reinforced with brass.
 2. Maximum working pressure: 430 psig.

2.6 REFRIGERANT PRESSURE REGULATORS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - 3. Sporlan Valve Co.
- B. Brass body, stainless steel diaphragm, pilot operated with remote pressure pilot, adjustable over 0 to 80 psig range, for maximum working pressure of 450 psig.

2.7 REFRIGERANT PRESSURE RELIEF VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division.
 - 3. Sporlan Valve Co.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; setting selected to ASHRAE 15.

2.8 REFRIGERANT FILTER-DRIERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - 3. Sporlan Valve Co.
- B. Replaceable Cartridge Angle Type:
 - 1. Shell: ARI 710, UL listed, steel, removable cap, for maximum working pressure of 500 psig, and wrought copper fittings for solder end connections.
 - 2. Filter Cartridge: Pleated media with integral end rings, stainless steel support.
 - 3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumin to provide micronic filtration.
 - 4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.
- C. Permanent Straight Through Type:

1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.
2. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

2.9 REFRIGERANT SOLENOID VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co.
- B. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, solder ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.
- C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture, and fungus proof, with surge protector and color-coded lead wires, integral junction box.

2.10 REFRIGERANT EXPANSION VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co.
- B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum ten (10) degrees Fahrenheit superheat. Select to avoid being undersized at full load and oversized at part load.

2.11 REFRIGERANT PIPING INSULATION

- A. Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
 2. Insulation shall be Armaflex Ultra pipe insulation. Provide 1-inch insulation thickness. All seams and joints shall be adhered and sealed using Armaflex 520

adhesive. All fittings shall be insulated with same insulation thickness as straight pipe.

3. **Exposed refrigerant liquid and suction piping (located indoors and/or outdoors)**: shall be insulated and include two (2) coats of WB Armaflex Finish. In addition, liquid and suction lines shall be provided with aluminum jacketing; provide 0.016-inch Type 3105 on all exterior insulated piping. Fitting covers shall be 0.024-inch Type 1100 aluminum. Jacketing and fitting covers shall be banded with 0.20-inch Type 3105, 1/2-inch-wide banding with 0.32-inch Type 5005 wing seals on 12-inch centers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- E. Install pipe identification in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Arrange refrigeration piping to return oil to compressor. Provide traps and loops in piping, and where necessary provide double risers. Slope horizontal piping 0.40 percent in direction of flow.
- H. Provide access where valves and fittings are not exposed.
- I. Flood refrigerant piping system with nitrogen when brazing.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 00.

- L. Install valves with stems upright or horizontal, not inverted.
- M. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.
- N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Provide electrical connection to solenoid valves.
- R. Fully charge completed system with refrigerant after testing.
- S. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- T. Install refrigerant piping in accordance with ASME B31.5.
- U. Install piping in as short and direct arrangement as possible to minimize pressure drop.
- V. Install piping with minimum number of joints using as few elbows and other fittings as possible.
- W. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
- X. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
- Y. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
- Z. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- AA. Slope refrigerant piping as follows:
 - 1. Install horizontal hot gas discharge piping with 1/2 inch per ten (10) feet downward slope away from the compressor.
 - 2. Install horizontal suction lines with 1/2 inch per ten (10) feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - 3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 - 4. Liquid runs

- BB. Use fittings for all changes in direction and all branch connections.
- CC. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- DD. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- EE. Conceal all pipe installation in walls, pipe chases, utility spaces, above ceilings, below grade floors, unless indicated to be exposed to view.
- FF. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with one (1) inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- GG. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing or valves.
- HH. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than six (6) inches shall be steel; pipe sleeves six (6) inches and larger shall be sheet metal.
- II. Fire Barrier Penetrations: Seal pipe penetrations through fire rated wall, partitions, ceilings, and floors, maintain the fire rated integrity.
- JJ. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- KK. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.
- LL. Install moisture / liquid indicators in liquid lines between filter / driers and thermostatic expansion valves and in liquid line to receiver.
 - 1. Install moisture / liquid indicators in lines larger than 2-1/8-inch OD, using a bypass line.
- MM. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.
- NN. Install flexible connectors at the inlet and discharge connection of compressors.

3.3 INSTALLATION - REFRIGERANT SPECIALTIES

- A. Refrigerant Liquid Indicators:
 - 1. Install line size liquid indicators in main liquid line downstream of condenser.
 - 2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
 - 3. Install line size liquid indicators downstream of liquid solenoid valves.

4. Install liquid indicator on leaving side of filter-driers.
- B. Refrigerant Valves:
1. Install service valves on compressor suction and discharge.
 2. Install gage taps at compressor inlet and outlet.
 3. Install gage taps at hot gas bypass regulators, inlet, and outlet.
 4. Install check valves on compressor discharge.
 5. Install check valves on condenser liquid lines on multiple condenser systems.
 6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.
- C. Strainers:
1. Install line size strainer upstream of each automatic valve.
 2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
 3. On steel piping systems, install strainer in suction line.
 4. Install shut-off valves on each side of strainer.
- D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.
- E. Filter-Dryers:
1. Install permanent filter-dryers in low temperature systems.
 2. Install permanent filter-dryer in systems containing hermetic compressors.
 3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
 4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.
- F. Solenoid Valves:
1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
 2. Install in liquid line of single or multiple evaporator systems.
 3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.4 PIPE JOINT CONSTRUCTION

- A. Brazed Joints: Comply with the procedures contained in the AWS: Brazing Manual".

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do not apply heat near the bulb of the expansion valve.
- B. Pressurize the pipe and fittings during brazing with nitrogen to prevent formation of harmful oxides.
- C. Heat joints using-acetylene torch. Heat to proper and uniform brazing temperature.

3.5 VALVE INSTALLTIONS - GENERAL

- A. General: Install refrigerant valves in accordance with manufacturer's instructions.
- B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- C. Install a full sized, 3-valve bypass around each drier.
- D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.
1. Coordinate electrical requirements and connections.
- E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
 2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
 3. Secure the bulb straps. Do not mount bulb in a trap or at the bottom of the line.
 4. Where external equalizer lines are required make the connection where it clearly reflect the pressure existing in the suction line at the bulb location.
- F. Install pressure regulating and relieving valves required by ASHRAE Standard 15.

3.6 EQUIPMENT CONNECTIONS

- A. Install piping adjacent to machine to allow servicing and maintenance.

3.7 FIELD QUALITY CONTROL

- A. Install, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.
- B. Repair leaking joints using new materials and retest for leaks.

3.8 CLEANING

- A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedures:
 - 1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
 - 2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - 3. Draw a clean, lintless cloth saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint.
 - 4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.9 ADJUSTING AND CLEANING

- A. Verify actual evaporator applications and operating conditions and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.10 SYSTEM CHARGING

- A. Charge system using the following procedure:
 - 1. Install core in filter dryer after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 microns. When vacuum holds for a minimum of 24 hours, system is ready for charging.
 - 3. During excavation, apply heat to pockets, elbows, and low spots in piping.
 - 4. Break vacuum with refrigerant gas, allow pressure to build up to 2 psig.
 - 5. Charge system with a new filter-dryer core in charging line.
- B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, trouble shooting, servicing, and preventive maintenance of refrigerant piping valves and refrigerant piping specialties.
- C. Review data in Operating and Maintenance Manuals.
- D. Schedule training with Owner with at least seven (7) days advance notice.

END OF SECTION 23 23 00

SECTION 23 25 13 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- B. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- C. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

- A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.4 DESCRIPTION OF WORK

- A. Work Included: Perform water analysis and provide all water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified hereinafter as follows:
 - 1. Chilled Water Systems
 - 2. Heating Water Systems
- B. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for three months after acceptance by the Owner.
- C. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.
- D. Testing Equipment and Reagents: Furnish suitable water treatment equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three months after acceptance by the Owner.
- E. Service Representative: Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems and tests required. Service representative shall return to the site bi-weekly during first 2 months of operation and monthly during the remainder of the guarantee period. At such time, service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.
- F. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment at no additional cost to the Owner for 1 year after successful start-up of the system. All warranty work shall be FOB as installed at the project site.

1. Guarantee: Provide system produced by manufacturer who is willing to execute the required guarantee.
2. Agreement to Maintain: Provide system produced by manufacturer who is willing to execute (with the Owner) the required agreement for continued maintenance of the system.

1.5 QUALITY ASSURANCE

- A. Qualifications: The Contractor for work under this Section shall have:
1. Research and development facilities.
 2. Regional laboratories capable of making water analysis.
 3. A service department and qualified technical service representative located within a reasonable distance of the project site.
 4. Service representatives who are Registered Engineers of factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.
- B. Packaging and Labeling: Supply water treatment chemicals in metal drums, fiber drums with plastic liners, or plastic lined "liqui-paks" as best suited to the materials. Paper bags or unlined cardboard cartons will not be acceptable. Use only chemicals in domestic water systems, all coincides regardless of where used, which are registered with the U.S. Department of Agriculture (USDA) or the U.S. Environmental Protection Agency (EPA) and which are labeled as required by law.
- C. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.
- D. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

1.6 SUBMITTALS

- A. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.
- B. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, piping, and tubing sizes, fittings, accessories, valves and connections.
- C. Guarantee: Submit written guarantee signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required achieving the required performance, during a 1-year period following the final start-up or the continued operation of the chillers.
- D. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the chilled water treating system shall submit four copies of an "Agreement for Continued Service and the Owner's possible acceptance." Offer terms and conditions for furnishings chemicals and providing continued testing and equipment for a 1-year period with option for renewal of the Agreement by Owner.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Nalco
 - 2. Garratt-Callahan

2.2 GENERAL

- A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.
- B. **Pre-Treatment: For Flushing and Cleaning of Hydronic Piping, refer to specification section 23 25 19. Flushing and Cleaning of Hydronic Piping shall be performed by PurgeRite.**
- C. FDA and USDA Approval: use only FDA and USDA-approved products in system with direct connection to domestic water systems.
- D. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

2.3 CHILLED AND HEATING WATER SYSTEMS

- A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:
 - 1. Form a protective film to prevent corrosion and scale formation to maintain iron levels between 0.0 and 0.5 as Fe.
 - 2. Scavenge oxygen and protect against scale
 - 3. Remain stable throughout operating temperature range
 - 4. Are compatible with pump seals and other elements in the system.
 - 5. For aluminum condensing boilers, molybdate at 10 to 25 ppm and maintain pH limit below 8.5; refer to boiler manufacturer's recommendation.
 - 6. Chilled Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor compound at 650 to 750 ppm as NO₂ (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.
 - 7. Heating Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor compound at 750 to 1,000 ppm as NO₂ (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.
- B. Equipment: Provide a bypass feeder with a 5-gallon capacity. The feeder shall be constructed of 10-gauge steel and impervious to the products dispensed. Tank heads shall be a minimum of 9-gauge steel and shall be rated at 300 psi and to 200°F. Chemical feeder shall have inlet and outlet drain valves with full bottom drain. The tank

shall have a wide mouth, 3-1/2" opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal. Closures rated less than 300 psi shall not be considered equal.

The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall use a square ring gasket seal. The ring gasket shall not be glued or restrained from movement. Closures using "o" rings or gaskets which are glued or restrained from free movement by snap rings shall not be considered equal.

Provide bypass feeder with legs to elevate the feeder off of the floor. The legs shall have holes to allow mounting to anchor bolts.

The bypass feeder shall be provided with a 5-micron filter bag fully supported by a stainless-steel filter basket for simultaneous side stream filtering.

1. Acceptable Manufacturer: Neptune, model FTF-5DB.

C. Test Kit: Provide test kit and reagents for determining proper water conditions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

- A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work.
- B. Testing: Perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

3.2 FLUSHING:

- A. Drain preparation and boil out products from the systems. Flush with clean water until system tests prove systems are free of preparation and boil out products and other contaminants prior to administering system water treatment as specified hereinbefore.

3.3 CHILLED AND HEATING WATER SYSTEM:

- A. Treatment: Treat initial water charge to chilled water loop at 650-750 ppm as NO₂ and heating water loop at 750 to 1000 as NO₂ water systems, after system has been flushed and prepped, to achieve a water quality as specified.
- B. Start-up Procedures: During chilled and heating water system start-up, operate chilled and heating water treating systems (after charging with specified chemicals) to maintain the required steady-state characteristics of cooling and heating water. Demonstrate system operation to Owner's operating personnel.
- C. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:

- 1. D 859 - Tests for Silica in Water and Water Waste

- | | | | | |
|----|---|------|---|--|
| 2. | D | 1067 | - | Tests for Acidity or Alkalinity of Water |
| 3. | D | 1068 | - | Tests for Iron in Water and Wastewater |
| 4. | D | 1126 | - | Tests for Hardness in Water |
| 5. | D | 1128 | - | Tests for Identification of Types of Microorganisms and Microscopic Matter in Water and Wastewater |
| 6. | D | 3370 | - | Sampling Water |

- D. Water Chemistry: Where water chemistry substantiates that pH is not necessary, chemical fee shall be based on water makeup qualities. Water analysis shall be based on the full parameters of operation, and all possible water supplies. Total hardness and "M" alkalinity of the makeup water will be the determining factor along with the technical limitations of the inhibitors.

3.4 PERSONNEL TRAINING:

- A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water treating systems including preparation of chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.

END OF SECTION 23 25 13

SECTION 23 25 19 – FLUSHING AND CLEANING OF HYDRONIC PIPING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- B. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

- A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries.

1.4 DESCRIPTION OF WORK

- A. Work Included: Perform water analysis and provide all water cleaning products, holding reservoirs, equipment and labor for cleaning, and flushing to control water quality for each system.
- B. Testing Equipment and Reagents: Furnish suitable water flushing and cleaning equipment for each system, complete with apparatus and reagents necessary.

1.5 QUALITY ASSURANCE

- A. Qualifications: The Contractor for work under this Section shall have:
 - 1. A service department and qualified technical service representative located within a reasonable distance of the project site.

1.6 SUBMITTALS

- A. Test reports: Submit test reports certified by an officer of the firm on company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.

PART 2 – PRODUCTS

2.1 PROFESSIONAL FLUSHING AND CLEANING SERVICES PERFORMED BY:

- A. PurgeRite, a third-party flushing company will be used for flushing and cleaning of the HVAC related piping.

Website:
www.purgerite.com

Email:

sales@purgerite.com

Phone:

936-344-6210.

Address:

13805 N. Highway 75, Suite B

Willis, TX 77378

2.2 GENERAL

- A. Pre-Treatment: For new construction and/or renovations to existing hydronic systems, flush and clean all hydronic piping systems to remove and permit flushing of mill scale, oil, grease and other foreign matter. A school district supervisor is to be present to observe cleaning of hydronic piping systems. Systems shall not be started up until the piping has been cleaned.

2.3 FLUSHING AND CLEANING OF STEEL PIPING SYSTEM:

- A. After the mechanical contractor has tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the closed loop chilled and hot water systems as specified herein. Systems must be commissioned as clean and meet water treatment specifications.
- B. All chilled and hot water piping and related equipment shall be thoroughly flushed out with pre-cleaning chemicals designed to remove deposits such as pipe dope, oils, loose rust, mill scale and other extraneous materials. Recommended dosages of pre-cleaner chemical products shall be furnished by water treatment supplier, added and circulated throughout the water systems. The water system shall then be diluted and final flushed thoroughly until no foreign matter is observed and total alkalinity of the water is equal to or better than that of the make-up water.
- C. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at each coil and heat exchanger during the flushing and cleaning operation.
- D. Self-contained flush unit requirements will contain a pump, or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include, at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.
- E. Flushing Procedure Guidelines:
 - 1. Pre-flush: Bypass loops should be installed in front of any strainers and control valves at all equipment components. Coordinate with PurgeRite for proper sizing and placement of bypasses and flush ports.
 - 2. Install temporary strainer elements in front of pumps, tanks, solenoid valves, control valves, and other equipment where permanent strainers are not indicated that are not bypassed. Keep these strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow-off valve. Strainers should be removed when a self-contained flush unit is used in conjunction with on board filtration.

3. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush process. A water dump location should be identified which as well is usually the sanitary.

F. Clear Water Flush

1. Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 -7 ft. /sec throughout. Filtration should be at minimum, 50 microns. This flush shall continue until the system water is comparable to the make-up water. Iron content should be under 2.0 ppm.

G. Cleaning & Passivation

1. The second flush cycle is a combined flushing cycle where cleaning and passivation chemicals are introduced into the system to clean the oils and treat the inside wall of the piping system. This process will be monitored by the chemical treatment company to meet the chemical specifications of the water. The cleaning velocity should be between 3 to 5 ft. /sec throughout, and the circulation time will be based on the chemical testing, but will be at minimum, 24 hours.

H. Final Clear Water Flush

1. The system will be continuously flushed while discharging chemicals into the sanitary system as approved locally. As the existing treated water is being discharged, a freshwater make-up source will be utilized to ensure air is not introduced into the system. Continue to drain the system while adding domestic water to dilute the treated water. The chemical treatment company will monitor the outgoing water composition and compare the composition with the incoming water. Flush with fresh water until the conductivity is reduced to that of the make-up water and iron meets specifications. The final system water should be approved by the chemical treatment company. Filtration should be 5 microns.

I. Final Chemical Fill

1. Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important the water not be left stagnant.
2. Verify satisfactory completion of clean piping and a final flushing and chemical treatment report should be submitted by field personnel. The report should include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.
3. Cleaning chemicals, procedure, water testing, reporting, and consultation must be provided by a qualified water treatment company specializing in this type of work.

2.4 FLUSHING AND CLEANING OF PEX, POLYPROPYLENE, OR HDPE PIPING SYSTEMS:

- A. After the mechanical contractor has tested the piping, it is to be flushed and cleaned for service. Provide a complete water flushing and cleaning of the piping as specified herein. Systems must be commissioned as clean.
- B. All temporary connections required for flushing, cleaning, purging, and circulating shall be included. Provide suitable pipe bypasses at any equipment or building during the flushing and cleaning operation.
- C. Self-contained flush unit requirements should contain a pump, or pumps connected that will meet or exceed the volume required to flush and purge the system at the required velocity rate through the largest pipe. Pump curve will be submitted along with other important documentation for the related equipment on the unit. This will include at minimum, filtration, flow meter(s), pressure gauges, and unit description or picture. All operators will comply with all safety regulations of the project site. The flushing operation will be manned continuously during the flushing process.
- D. Flushing Procedure Guidelines

1. Pre- Flush:

Bypass loops should be installed at all equipment or building components. Strainers should be removed when a self-contained purge unit is used in conjunction with on board filtration. Flush ports should be identified along with the type of high-pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush.

2. Clear Water Flush:

Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 – 7 ft. /sec throughout. Filtration should be at minimum, 5 microns. Minimum duration should be calculated using a formula of 1 hour per 1000' of linear pipe and until system water is comparable to make up water source. The minimum circulation time should be 1 hour regardless of the length.

3. Final Chemical Fill

Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system if required. Once the system is filled with the final chemicals it is important the water is not left stagnant and to mix chemicals.

Verify satisfactory completion of clean piping and a final flushing report will be submitted by field personnel. The report will include at minimum, project name, date, location, parties involved, type of pipes treated, scope summary, flows, durations, and other relevant information.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

- A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and

in the concentration recommended by the water treatment manufacturer for this portion of the work.

- B. Testing: Perform test procedures and submit a written final report (at each phase if applicable) of test conditions and results to the Contractor and Consulting Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

END OF SECTION 23 25 19

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and Flat Oval ducts and fittings.
 - 3. Double-wall rectangular ducts and fittings.
 - 4. Double-wall round and Flat Oval ducts and fittings.
 - 5. Double-wall flat oval / round / rectangular outdoor ductwork.
 - 6. Insulated Flexible Ducts
 - 7. Sheet metal materials.
 - 8. Sealants and gaskets.
 - 9. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
 - 3. Division 23 Section "Duct Insulation" for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products:
 - 1. Adhesives.

2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. $\frac{1}{4}'' = 1'-0''$ Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
- 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.
- B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Envirotech Mechanical Systems
 - 2. Gurry Mechanical L.P.
 - 3. Letsos Company
 - 4. Mason Road Sheet Metal Inc.
 - 5. McCorvey Sheet Metal Works
 - 6. Telkin Sheetmetal, Inc.
 - 7. Titans Metals
 - 8. Tomball Sheet Metal Co.
 - 9. MLN
 - 10. Walsh & Albert
 - 11. Grant Sheet Metal
 - 12. Tennapel Sheet Metal
 - 13. McGill AirFlow LLC.
 - 14. Texas Duct Systems
 - 15. South Texas Sheet Metal
 - 16. Texas Air Duct Systems
 - 17. SEMCO Incorporated
 - 18. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Sheet Metal Connectors, Inc
- D. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- G. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titans Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- D. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

- G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titans Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
- H. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titans Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

- D. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.

2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Envirotech Mechanical Systems
 2. Gurry Mechanical L.P.
 3. Letsos Company
 4. Mason Road Sheet Metal Inc.
 5. McCorvey Sheet Metal Works
 6. Telkin Sheetmetal, Inc.
 7. Titans Metals
 8. Tomball Sheet Metal Co.
 9. MLN
 10. Walsh & Albert
 11. Grant Sheet Metal
 12. Tennapel Sheet Metal
 13. McGill AirFlow LLC.
 14. Texas Duct Systems
 15. South Texas Sheet Metal
 16. Texas Air Duct Systems
 17. SEMCO Incorporated
 18. Lindab Inc.
 19. Linx.
- B. Fabricate ducts with indicated dimensions for the inner duct.
- C. Material:
1. Outer Duct: 18-gauge epoxy coated galvanized duct.
 2. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.
- D. Inner Duct: 20 gauge perforated galvanized duct.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.
1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
- F. Exterior Coating / Finish.
1. Epoxy coated exterior duct.
 2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.
 3. Coordinate color with the architect and the owner.

2.6 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thermaflex Type M-KE.
 - b. Atco
- B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.
 - a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
 - b. Maximum Velocity: 4,000 fpm.
 - c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
 - d. Thermal Resistance: Minimum R-6 installed.
 - e. Maximum flexible duct length shall not exceed 5'-0".
- C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to "23 33 00 Air Duct Accessories"; 2.10 Flexible Duct Elbow Supports.

2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS

- A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent, or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8" relief hood at roof penetration with roof curb, flashing and counter flashing.

3.3 REQUIREMENTS OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint all outdoor ductwork, exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers, and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 DUCT STORAGE / CLEANING

- A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not "dried-in". If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.

- B. The working area shall be clean, dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria's, Libraries, etc.: Double wall insulated round ductwork.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 - 2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 - 3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 3.
- C. Return and Outside Air Ducts:
 - 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 - 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.

- c. SMACNA Leakage Class for Rectangular: 12.
- d. SMACNA Leakage Class for Round: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18-gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16-gauge Carbon-steel sheet.
 - c. Continuously welded seams and joints
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.
4. Ducts Connected to Dishwasher Hoods:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
5. Ducts Connected to Shower Return air grilles:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. Stainless-Steel Ducts:

- a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.
- F. Elbow Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 1. Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.
- G. Branch Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1,000 fpm or Lower: 90-degree tap.
 - b. Velocity 1,000 to 1,500 fpm: Conical tap.
 - c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 31 18- FABRIC DUCT

PART 1-GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. DESCRIPTION OF WORK

- A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.
- B. Types of non-metal ductwork required for this project include the following:
 - 1. Fabric Air Dispersion Products suitable for Natatoriums and Gymnasiums.

1.3. QUALITY ASSURANCE

- A. Building Codes and Standards:
 - 1. Product must be Classified by Underwriter's Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A and UL 2518.
 - 2. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.
- B. Design & Quality Control
 - 1. Manufacturer must have documented design support information including duct sizing; vent, orifice, and/or nozzle location; vent, orifice, and/or nozzle sizing; length; and suspension. Parameters for design, including maximum air temperature, velocity, pressure and textile permeability, shall be considered and documented.
 - 2. Manufacturer's Environmental Product Declaration (EPD) must be inclusive of the following:
 - a. Fabric.
 - b. Cutting, sewing, processing of DuctSox.
 - c. Zippers.
 - d. Metal suspension system parts and framework (if applicable).
 - e. Energy, water, recycled & waste of plant processing fabric & suspension.
 - f. Complete packaging including boxes, bags & staples.
 - g. Transportation.

1.4. SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.

- C. Building Code Data: Submit UL file number under which product is Classified by Underwriter's Laboratories for both NFPA 90-A and UL 2518.
- D. Provide detailed drawings confirming configuration of Textile Dispersion System (diameter, lengths, airflow, pressure, and textile permeability).
- E. Provide detailed installation instructions for components to be installed.
- F. Provide warranty and maintenance documentation.
- G. Provide product's Environmental Product Declaration (EPD) that includes the following:
 - 1. Fabric.
 - 2. Cutting, sewing, processing of DuctSox.
 - 3. Zippers.
 - 4. Metal suspension system parts and framework (if applicable).
 - 5. Energy, water, recycled & waste of plant processing fabric & suspension.
 - 6. Complete packaging including boxes, bags & staples.
 - 7. Transportation.

1.5. WARRANTY

- A. Manufacturer must provide a complete product (10) ten-year warranty for products supplied for the fabric and suspension of this system as well as a Design and Performance Warranty. Laundering frequency nor any other conditions shall pertain to warranty terms.

1.6. DELIVERY, STORAGE AND HANDLING

- A. Protect textile air dispersion system and Hoops (IHS) components from damage during shipping, storage, and handling.
- B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products manufactured in the United States by the following:
 - 1. DuctSox - Sedona-Xm.
 - 2. FabricAir, Inc. - Combi 80.

2.2 TEXTILE DISPERSION SYSTEM

- A. Air diffusers constructed with internal tensioning frame.
 - 1. System shall cylindrically tension fabric along the entire length of fabric duct, including all fittings (crosses, elbows, reducers, and tees).
 - 2. Tensioning system shall include full 360-degree tensioning and intermediate rings with quick connection spacer tubes concealed inside the fabric system.
 - 3. Interior structure to include multiple mechanically adjustable tension devices. To provide proper fabric tensioning, structural and fabric system shall be configured in segments of no more than 42 feet.
 - 4. Fabric components supported solely by metal cylindrical rings.
 - 5. Each cylindrical ring shall require vertical metal to metal vertical cable safety attachment.
- B. Air diffusers constructed with external structural frame.
 - 1. The system shall be made with sewn in but removable aluminum hoops. The hoops shall:
 - a. Maintain the ducts' cylindrical shape at all times.
 - b. Be made to a circular arc angle of 180° (8" - 48"), 120° (49" - 60"), 90° (61" - 68") or 60° (69" - 80") depending on duct diameter.
 - c. Shall be centered at the 12:00 o'clock position of the duct.
 - d. Shall be installed at the factory, on-site installation shall not be allowed.
 - 2. Diameter and spacing of hoops shall be determined by the manufacturer based on duct diameter.
 - 3. Elbows of 70° or more shall have at least two hoops.
 - 4. Air dispersion shall be accomplished with linear or polar arrays of laser cut orifices. Size of laser cut orifices shall be from 1" to 5" diameter. Due to exact throw requirements and NC requirements alternative flow models are not acceptable.
 - 5. Number of orifices shall be determined by manufacturer.
 - 6. Fabric system shall include connectors to attach to suspension system.
 - 7. If within a natatorium, all metal structural components shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.
- C. TEXTILE
 - 1. Sedona-Xm

- a. Textile Construction: Filament / filament twill polyester treated with a machine washable anti-microbial agent by the fabric manufacturer, fire retardant in accordance with UL 2518.
 - b. Air Permeability: 2 (+2/-1) CFM/ft² per ASTM D737, Frazier.
 1. The air permeability of the fabric must NOT be created by perforating the fabric.
 2. The air permeability must be confirmed by third party testing to eliminate the formation of condensate on the fabric.
 - a. Weight: 6.8 oz. /yd² per ASTM D3776.
 - b. Warranty: 10 years.
2. Textile Color
 - a. Standard: blue, white, tan, red, green, silver, black.
 - b. Custom.

D. TEXTILE SYSTEMS FABRICATION REQUIREMENTS

1. Provide system in modular lengths optimized for maintenance, connected by zippers with proper radial securing clips (inlets, endcaps and mid-sections) and top access zippers (if required) for vertical cable safety attachment. Zippers shall provide closure completely around the circumference to prevent leakage. Required number of zippers shall be specified by the manufacturer.
2. Integrated air dispersion outlets (orifices, nozzles, linear vents or other) shall be specified and approved by manufacturer.
3. The system shall be made of permeable fabric. Base permeability of fabric shall be reached based on a combination of weave construction and a thermo fixation process in order to prevent permeability degradation after wash. Fabric permeability based on a calendaring process is not acceptable.
4. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via zip screw fastener – supplied by contractor.
5. Inlet connection includes zipper for easy removal / maintenance.
6. Lengths to include required intermediate zippers as specified by manufacturer.
7. End cap includes zipper for easy maintenance.
8. Each section of the fabric shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information

E. DESIGN PARAMETERS

1. Fabric air diffusers shall be designed from 0.25" water gage minimum to 3" maximum, with 0.5" as the standard.

2. Fabric air diffusers shall be limited to design temperatures between -40°F and +284°F.
3. Design CFM, diameter, dispersion, static pressure, and diffuser length shall be designed or approved by the manufacturer.
4. Do not use fabric diffusers in concealed locations.
5. Use fabric diffusers only for positive pressure air distribution components of the mechanical ventilation system.

PART 3 – INSTALLATION

3.1 INSTALLATION OF TEXTILE AIR DISPERSION SYSTEM

- A. Install chosen suspension system with minor noise and fabric motion at start-up in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with product. Suspension Track and cable within a natatorium shall be able to withstand chlorinated environment and shall not be susceptible to corrosion. Provide necessary coatings and materials.

3.2 CLEANING AND PROTECTION

- A. Clean air handling unit and ductwork prior to the fabric air dispersion system unit-by-unit as it is installed. Clean external surfaces of foreign substance which may cause corrosive deterioration of facing.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.
- C. If fabric dispersion system becomes soiled during installation, they should be removed and cleaned following the manufacturers standard terms of laundry.

END OF SECTION 23 31 18

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Back-draft dampers.
 - 2. Combination fire-and-smoke dampers.
 - 3. Duct access doors.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Volume control dampers.
 - 7. Flexible duct connections
 - 8. Duct Taps
 - 9. Duct test holes
 - 10. Flexible duct elbow supports
- B. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings: Requirements for duct construction and pressure classifications.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

1.6 COORDINATION

- A. Coordinate Work where appropriate with building control Work.
- B. Coordinate fire alarm wiring requirements with Division 26.

1.7 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

1.8 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Arrow United Industries
 - 2. American Warming and Ventilating
 - 3. Ruskin
 - 4. Air Balance
 - 5. NCA
 - 6. Pottorff
 - 7. Greenheck
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.
- E. Temperature rating: 250°F.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.
- G. Coordinate fire alarm control wiring with Division 26.
- H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.
- I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.
- J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.
 - 1. Less Than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck

- B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.
- C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.
- D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.
- E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.
- G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with UL 555S, Leakage Class I.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.
- E. Temperature rating: 250°F.
- F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.
 3. Operator: Minimum 1/4-inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct height up to 12".
- D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12" and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.
- E. Damper Blades:
1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.
 2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.
 3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.
- F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.
- G. Quadrants:
1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.
 2. On insulated ducts mount quadrant regulators on 2" standoff mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
 4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.
- H. Actuators:
1. Maximum damper area per actuator shall be 24 square feet face area.
 2. Actuators shall be two position or modulating spring return type.
 3. Duct mounted dampers shall have actuators mounted outside of air stream.
 4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately six (6) inches wide.
 - 3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.
 - 4. Install flexible connections with a minimum of one (1) inch between metal edges.
 - 5. Provide flexible duct connections at every duct connection to equipment.
- C. Application:
 - 1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

2.8 DUCT TAPS

- A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.
- D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.
- B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.
- B. Provide elbow supports at each diffuser connection.
- C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 REPORTS

- A. Per NFPA 90A, all fire dampers, smoke dampers and fire/smoke dampers must be tested prior to occupancy and contractor shall provide written confirmation if the dampers are operating as required. Provide pass / fail report in excel spreadsheet. Include type of damper, damper manufacturer / model, actuator manufacturer / model, fusible link in the excel spreadsheet.
- B. Contractor to provide as-built drawings of location of all fire, smoke and fire/smoke dampers with appropriate label that matches the installation.
- C. Per NFPA 80, contractor shall test and inspect all dampers prior to one (1) year warranty period. All inspections, testing and maintenance of dampers must be documented, indicating the location of the damper, date(s) of inspection, name of inspector and deficiencies discovered. The document must have a space to indicate when and how the deficiencies were corrected. All documentation is expected to be maintained and made available for review by the AHJ.
- D. After first year, test and inspection frequency must be every 4 years.

3.3 INSTALLATION.

- A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.
- C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.

- F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.
- G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
 - 3. Install stainless steel volume dampers in stainless steel ducts.
 - 4. Install aluminum volume dampers in natatoriums.

3.4 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 33 19 - DUCT SILENCERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Duct silencers.
 - 2. Crosstalk silencers.
 - 3. Ductwork lagging.

1.3 PERFORMANCE REQUIREMENTS

- A. Sound control components are selected to maintain the sound level of space at levels not to exceed those listed below. The midpoint of Noise Criteria (NC) curves shall apply.
- B. Sound control components are designed to maintain rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by HVAC Applications and ANSI S1.8.
 - 1. **Offices**
 - a. Executive: 30
 - b. Conference rooms: 30
 - c. Private: 35
 - d. Open-plan areas: 35
 - e. Computer/business machine areas: 40
 - f. Public circulation: 40
 - 2. **Schools**
 - a. Lecture and classrooms: 30
 - b. Open-plan classrooms: 35
 - 3. **Libraries:** 25
 - 4. **Theaters**
 - a. Theater: 25
 - b. Stage house: 25
 - c. Trap room: 25
 - d. Orchestra pit: 25
 - e. Rehearsal rooms: 25
 - f. Teaching studios: 30
 - g. Practice rooms: 30
 - h. Ensemble rooms: 30
 - i. Shop: 45

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Shop Drawings: Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- C. Product Data: Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- D. Design Data: Submit selection of each individual trap. Selection shall indicate airflow and pressure drop. Sound attenuators shall be selected based on full return airflow.
- E. Test Reports: Indicate acoustic housings meet or exceed specified sound transmission loss values.
- F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- G. Manufacturer's Certificate: Certify silencers meet or exceed specified requirements.
- H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of crosstalk silencers, acoustic housings, duct silencers and ductwork lagging. Record actual locations of hangers including attachment points.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, ANSI S12.36, standards and recommendations of ASHRAE 68.
- B. Combustion ratings for the silencer acoustic fill material shall not be greater than the following when tested to ASTM E84, NFPA Standard 255 or UL No. 723:
 - 1. Flame Spread Classification: 20
 - 2. Smoke Development Rating: 20
 - 3. Fuel Contribution: 20

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) year's experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- B. Do not deliver Equipment to the project site until progress of construction has reached the stage where sound attenuators are actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Aerosonics
 2. United McGill
 3. IAC
 4. Vibro-Acoustics
 5. Dynasonics
 6. Commercial Acoustics
 7. Ruskin
 8. Price
- B. Description: Sheet metal outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal with integral interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Configuration:
1. Tubular with inner casing and liner, aerodynamically shaped center body with nose cone and truncated tail cone, diameter and length as indicated on Drawings.
 2. Rectangular with lined splitters with radius nose and contoured tails. Size as indicated on Plans.
- D. Materials:
1. Outer Casing: Minimum 22 gage thick galvanized steel stiffened with mastic filled lock formed seams, two (2) inch long, 11 gage button punched slip joints on both ends.
 2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.
 3. Fill: Glass fiber or mineral wool of minimum 3 lb/cu ft density with antimicrobial and erosion coatings.
- E. Rating:
1. ASTM E477 Insertion Loss and Maximum Generated Noise based on 1000 fpm Face Velocity. Performance criteria listed below based on IAC model LFM:

Insertion Loss (dB)

Length - Octave Band Center Frequency (Hz)

DUCT SILENCERS
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		63	125	250	500	1000	2000	4000
Forward Flow	3 FT	4	7	13	16	15	10	9
	5 FT	6	10	17	25	25	14	11
Reverse Flow	3 FT	5	7	13	17	16	11	10
	5FT	7	12	19	27	27	14	13

Generated Noise (dB)

		Octave Band Center Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Forward Flow (all lengths)			32	24	32	25	34	39
Reverse Flow (all lengths)			31	30	34	35	40	45

2. Maximum static pressure shall not exceed 0.17 inches wg.
3. Return air silencers installed at mechanical room walls shall be sized for full design return flow to mechanical room. Outside air and exhaust air shall not be subtracted from return in order to ensure silencers operate within design parameters for all modes of operation.

2.2 CROSS-TALK SILENCERS / TRANSFER DUCT

- A. Description: Double wall sheet metal duct elbow with 1" insulation and perforated liner covering entire inside surface. Size as indicated on plans. Refer to Section 23 31 13 and detail on Plans.
- B. Casing: Construct elbow using duct gauges specified for size shown.
- C. Rating:
 1. Size transfer duct at a maximum of 500 fpm Face Velocity.
 2. Full design return air flow form space shall be used for sizing transfer ducts.
 3. Maximum static pressure loss through transfer duct shall not exceed 0.05 inches wg.

2.3 DUCTWORK LAGGING

- A. Acoustic Insulation: Two (2) inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.
- B. Covering: Gypsum board with surface weight minimum 4 lb/sq ft. All joints of covering shall be sealed as specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support duct silencers independent of ductwork.
- B. Install crosstalk silencers in wall. Pack and resiliently seal wall penetration.

- C. Lag ductwork at wall by wrapping with insulation and covering. Lagging of duct will be identified on the plans. Apply covering to be airtight. Do not attach covering rigidly to ductwork. Fire damper sleeve shall be lagged at wall penetration, no exception.
- D. Silencers shall be installed in accordance with manufacturer recommendations.
- E. Silencers installed in duct systems that generate excessive system effect and pressure drop shall be removed and installed correctly by contractor at no additional cost.
- F. Duct transition upstream of silencers shall be 30 degrees maximum. Duct transition downstream of silencer shall be 15 degrees maximum.
- G. Silencers shall be installed a distance of (3x duct diameter) from elbows.
- H. Silencers shall be installed a minimum of (1x duct diameter) from fan or unit outlets / inlets.
- I. Where multiple silencers are ganged together provide continuous galvanized steel nosing, crimped or button punched, on internal partitions.
- J. Silencers at mechanical room walls shall be installed with wall at midway point of casing. Pack and resiliently seal wall penetration. Silencers may be placed with overhang on either side of wall to allow coordination with trades.
- K. Silencers located at fire rated walls shall be connected to wall sleeve of damper. Provide duct lagging on damper sleeve.

END OF SECTION 23 33 19

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Hooded propeller roof fans
 - 2. Upblast centrifugal roof fans
 - 3. Upblast centrifugal roof fans – Grease exhaust
 - 4. Centrifugal filtered supply fans
 - 5. Inline Fans
 - 6. High Volume, Low Speed Fans
- C. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings - Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.8 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each fan with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
 - Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - Capacity (CFM) and static pressure (w.g.).
 - Motor Horsepower.
 - Fan RPM.
 - Unit Power Supply: Volts / PH / Amps.
 - Supply Fan Drive Type.

- Sales Order #.
- Date of unit manufactured.

PART 2 - PRODUCTS

2.1 HOODED PROPELLER ROOF FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Greenheck
 2. Cook
 3. Twin City
 4. ACME
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The powder coated steel fan housing shall include a minimum 14-gauge base with integral spun venturi and continuously welded or application of butyl tape to inside of the curb cap for maximum leak protection. The fan shall be enclosed with a minimum 18-gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by ½" x ½" galvanized steel screen. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Coating: All ungalvanized steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000-hour salt spray under ASTM B117 test method.
- F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7-gauge steel hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- H. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Drives: Shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch. Damper shall be epoxy coated.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.2 UPBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
 - 4. ACME
- B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Drives: Shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch. Damper shall be epoxy coated.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.3 UPBLAST CENTRIFUGAL ROOF FANS - GREASE EXHAUST

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
 - 4. ACME
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller ventilator. Coordinate drive with fan schedule on drawings.
- C. Unit shall be constructed in accordance with UL 762. Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An external wiring compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a 14-gauge steel power assembly. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A one (1) inch thick, three-pound density foil back heat shield shall be utilized to protect the motor and drive components from excessive

heat. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- G. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours.
- H. Drives: Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26.
 - 2. Direct drive units shall be provided with motor speed control option.
 - 3. Provide minimum 10" tall, vented curb extension.
 - 4. Provide grease trap with drain connection.
 - 5. Provide heat baffle.
 - 6. Provide Clean-Out Port.

2.4 CENTRIFUGAL FILTERED SUPPLY FAN - KITCHEN HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
 - 4. ACME
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Description: Fan shall be a side intake, roof mounted, belt driven, centrifugal filtered supply fan.
- D. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- E. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge galvanized steel, bolted to a minimum 16-gauge steel fan base with pre-punched mounting holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an

engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- F. Wheel: Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- H. Bearings: Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Drives: Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch. Damper shall be epoxy coated.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.5 INLINE FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
 - 4. ACME
- B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.
- C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.
- D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior

components. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

- E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.
- F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.
- H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.
- I. Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.
 - 2. Gravity actuated back-draft damper with adjustable counterweight. Damper shall be epoxy coated.
 - 3. Direct drive units shall be provided with motor speed control option.
 - 4. Companion Flanges: For inlet and outlet duct connections.
 - 5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.6 HIGH VOLUME, LOW SPEED FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. MacroAir: AVDX
 - 2. Big Ass Fans: Powerfoil D
- B. Construction: Fan shall be TUV certified and built pursuant to the construction guidelines set forth by the UL standard 507 and CSA standard 22.2. No. 113. The fan shall be designed to move an effective amount of air for cooling and destratification in commercial applications. The sound levels from the fan operating at maximum speed shall not exceed 61 dBA (measured 20' or below the blades and 20' or horizontally from the center of the fan).

- C. Air Foils: The fan shall be equipped with high volume, low speed airfoils of precision extruded, anodized aluminum alloy, and an anodized finish. The airfoils shall be connected to the hub and interlocked with high strength steel retainers and two (2) sets of high strength steel locking bolts and washers per airfoil.
- D. Motor: The fan motor shall be a permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0-100%. The motor shall be non-ventilated, heat sink design with the capability of continuous operation in 14°F to 122°F ambient conditions.
- E. Hub: The fan hub shall be constructed of zinc plated steel or aluminum for high strength and durability. The hub shall be machined to achieve a well-balanced and solid rotating assembly. The motor housing shall be provided with pressed in steel studs to securely accept removable, anodized aluminum beam struts.
- F. Mounting System: The fan mounting system shall be designed for quick and secure installation from a variety of structural supports. The fan mounting system shall be equipped with hardware, no less than SAE grade 5 for safe installation. The fan shall be equipped with a universal mount. The mounting system shall be powder coated for appearance and resistance to corrosion. All mounting bolts shall be metric stainless steel or equivalent. No mounting hardware substitutions, including cast aluminum are acceptable. The fan extension tube shall be a round, extruded aluminum tube.
- G. Safety Cables: The fan shall be equipped with upper and lower safety cables. The upper safety cable shall provide an additional means of securing the fan assembly to the building structure. The lower safety cable shall provide an additional means of securing the motor unit to the mounting system. All safety cables shall be 3/16" diameter and fabricated out of 7x19 braided galvanized steel. Field construction of safety cables is not permitted.
- H. Controller: The controller shall be incorporated into the fan assembly. The controller shall be factory programmed to minimize starting and breaking torques. The controller shall be housed in an enclosure to prevent accidental contact with the enclosed equipment and to prevent entry of unwanted substances.
- I. Fire Control Panel Integration: The fan shall be capable of receiving a stop command from the Fire Alarm Panel, ASD, or any amount of smoke, flame, or heat detectors. The fire alarm contractor shall furnish and install a relay for fire alarm control. Fans shall be interlocked to shut down immediately upon receiving a water flow signal from the alarm system in accordance with requirement of NFPA 72 – National Fire Alarm and Signaling Code.
- J. Wall Control: The fan shall be equipped with a low voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control shall include a touchscreen wall controller capable of multiple fan functions. Communication with the fan drive and controller shall be a standard, commercially available CAT 5 (or higher) Ethernet cable that is field installed and provided by the installer.
- K. Warranty:
 - 1. Furnish fifteen (15) year manufacturers' warranty for high volume low speed fans on the airfoils and mounting hardware. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup will not be acceptable. Startup and installation to be done by factory authorized representative.

2. Furnish fifteen (15) year electrical warranty on the motor, VFD, and fan controller.
 3. Startup must be performed by factory authorized representative to get the full 15-year electrical warranty.
 4. The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer (including all transportation charges).
 5. The warranty shall not require the submission of a post installation form or photographs of the installed fan(s) to the manufacturer for the warranty to be in effect.
 6. The warranty shall not require the periodic submission of maintenance records for the warranty to remain in effect.
- L. Accessories:
1. Provide clear lockable enclosure for wall controller with two sets of keys.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed, and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
- B. Install power ventilators level and plumb.
- C. Install dampers in roof curb damper tray.
- D. Provide hinged curb adapter to permit access to dampers and duct connection.
- E. Install safety screen where inlet or outlet is exposed.
- F. Provide sheaves required for final air balance.
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single duct air terminal units
 - 2. Dual-duct air terminal units
 - 3. Series Fan-Powered Air Terminal Units
- B. Related Sections:
 - 1. Section 23 09 23 – Direct Digital Controls: Controls remote from unit.
 - 2. Section 23 09 93 – Sequences of Operation for HVAC System.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work within shop coordination drawings.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- D. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.

- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Test and rate air terminal unit performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.
- C. All electrical components shall be UL Listed and installed in accordance with the National Electric Code. Electrical connections to terminal units shall be single point. The energy terminal shall be UL Listed as a complete assembly.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Filters shall be provided by air terminal unit manufacturer and not by the mechanical contractor.
 - 1. Fan-Powered-Unit Filters: Furnish [one] 1 spare filter(s) for each filter installed.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 COORDINATION

- A. Coordinate Work with Section 23 09 23 - Direct-Digital Control System for HVAC.

1.10 WARRANTY

- A. Furnish one (1) year manufacturer warranty for air terminal units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Air Terminal Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus
 - 2. Price
 - 3. Metalaire
 - 4. Krueger

- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
- D. Casing: Minimum 22-gauge galvanized steel.
 - 1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.
 - 2. Air Inlets: Round stub connections or oval connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections.
 - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Heavy gauge galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 - 2. Damper Position: Normally open.
- F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
- G. Actuators shall be capable of supplying at least 35 inches per pound of torque to the damper shaft and shall be mounted externally for service access.
- H. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- I. Factory installed Electric-Resistance Heating Coils (where scheduled): Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
 - 1. Provide 480v / 3ph / 60Hz 4W wye single point power connection.

2. Stage(s): Refer to schedule.
 3. Access door interlocked non-fused disconnect switch.
 4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 5. Nickel chrome 80/20 heating elements.
 6. Airflow switches for proof of airflow.
 7. Fan interlock contacts.
 8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 9. Magnetic contactor for each step of control (for three-phase coils).
- J. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source for terminal units with electric heat.
1. Control Transformer (Required only for terminal units with electric heat): Factory mounted for control voltage. Coordinate equipment voltage requirement with electrical plans.
 2. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.
 3. The following equipment items are to be furnished by Specification Section 23 09 23 - Direct-Digital Controls and installed by air terminal unit manufacturer.
 - a. Auto temperature control card (DDC).
 - b. 24-volt damper actuator.
 4. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:
 - a. Volume Control Damper.
 - b. Multi-point flow sensor.
 - c. Controller enclosure.
 - d. Power transformer; required only for terminal units with electric heat. (Coordinate voltage with electrical plans).
- K. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- L. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.
1. Maximum discharge sound power level of 62 DB.
 2. Maximum radiated sound power level of 70 DB.
 3. DB level based on third octave band.
- M. Temperature sensor provided, wired, and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.

- N. For Sequence of Operation: Refer to Section 23 09 93.

2.2 DUAL-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Titus
 2. Price
 3. Metalaire
 4. Krueger
- B. Configuration: Two volume dampers inside unit casing with mixing attenuator section and control components inside a protective metal shroud.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
- D. Casing: Minimum 22-gauge galvanized steel.
1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.
 2. Air Inlets: Round stub connections or oval connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Heavy gauge galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in cold- and hot-deck air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
- G. Cooling and heating inlets shall have separate damper assemblies for complete pressure independent control of each airstream for variable or constant volume total discharge applications. Terminals with inlet dampers mechanically interconnected are not acceptable. The dampers shall be heavy gauge steel with solid shaft rotating in self-

lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent over-stroking and a synthetic seal to limit close-off leakage.

- H. Actuators shall be capable of supplying at least 35 inches per pound of torque to the damper shaft and shall be mounted externally for service access.
- I. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover.
 - 1. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.
 - 2. The following equipment items are to be furnished by Specification Section 23 09 23 – Direct Digital Controls and installed by air terminal unit manufacturer.
 - a. Auto temperature control card (DDC).
 - b. 24-volt damper actuator.
 - 3. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:
 - a. Volume Control Damper.
 - b. Multi-point flow sensor.
 - c. Controller enclosure.
- J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- K. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.
 - 1. Maximum discharge sound power level of 62 DB.
 - 2. Maximum radiated sound power level of 70 DB.
 - 3. DB level based on third octave band.
- L. Temperature sensor provided, wired and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.
- M. For Sequence of Operation: Refer to Section 23 09 93.

2.3 SERIES FAN-POWERED AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Titus
 - 2. Price
 - 3. Metalaire
 - 4. Krueger
- B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.

- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
- D. Casing: Minimum 20-gauge galvanized steel.
 - 1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.
 - 2. Air Inlets: Round stub connections or oval connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections.
 - 4. Access: Removable top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections; with airtight gasket and quarter-turn latches.
 - 5. Fan: Forward-curved centrifugal; direct-drive.
 - 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Heavy gauge galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 - 2. Damper Position: Normally open.
- F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in cold- and hot-deck air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
- G. Motor:
 - 1. Type: General Electric electronically commutated motor (ECM), variable speed dc brushless. Motor shall be complete and operated by a single-phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
 - 2. Fan-Motor Assembly Isolation: Rubber isolators.

3. Enclosure: Totally enclosed, air over.
 4. Enclosure Materials: Rolled Steel.
 5. Motor Bearings: Permanently lubricated ball bearings.
 6. Unusual Service Conditions:
 7. Efficiency: Premium efficient.
 8. NEMA Design: NEMA MG-1.
 9. Service Factor: 1.15.
 10. Motor Speed: Infinitely adjustable, factory provided and mounted PWM controller for adjustable fan speed control. PWM controller shall be field adjustable with standard screwdriver. Fan CFM shall be pre-set at factory as shown on plans.
 11. Electrical Characteristics:
 - a. Horsepower: Refer to detail
 - b. Volts: 277
 - c. Phase: Single.
 - d. Hz: 60.
- H. Construction Filters for induced air inlet: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Material: Pleated cotton-polyester media having 90 percent arrestance and minimum MERV 8.
 2. Thickness: 1 inch.
- I. Factory manufactured and mounted Induced air inlet and discharge air attenuator section: steel sheet outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal (Provide where scheduled).
1. Lining: Adhesive attached, 3/4-inch thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- J. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- K. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

- L. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source.
 - 1. Control Transformer: Factory mounted for control voltage. Coordinate equipment voltage requirement with electrical plans.
 - 2. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.
 - 3. Disconnect Switch: Factory-mounted, non-fuse type in control panel.
 - 4. The following equipment items are to be furnished by Specification Section 23 09 23 - Direct-Digital Controls and installed by air terminal unit manufacturer.
 - a. Auto temperature control card (DDC).
 - b. 24-volt damper actuator.
 - 5. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:
 - a. Volume Control Damper.
 - b. Multi-point flow sensor.
 - c. Controller enclosure.
 - d. Power transformer (Coordinate voltage with electrical plans).
- M. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- N. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.
 - 1. Maximum discharge sound power level of 62 DB.
 - 2. Maximum radiated sound power level of 70 DB.
 - 3. DB level based on third octave band.
- O. Temperature sensor provided, wired, and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.
- P. For Sequence of Operation: Refer to Section 23 09 93.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install ceiling access doors or locate units above easily removable ceiling components.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Section 233113 "Metal Ducts."
- D. Coordinate duct installations and specialty arrangements with Drawings.
- E. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

3.8 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow. Set units with heating coils for minimum 50 percent full flow.

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Air devices.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Titus
 - 2. Price
 - 3. Metalaire
 - 4. Kruger
- B. Mounting:
 - 1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.
 - 2. "T" Bar Ceilings: Lay-in type.
 - 3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.
- C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.
 - 1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".
 - 2. Shall have a fire resistance rating of 3 hours.

3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.
 4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.
 5. UL listed thermal blanket insulation, mineral fiber around entire diffuser.
 6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.
- D. Source Quality Control
1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Accessories:
1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify ceiling and wall systems are ready for installation.
- E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.
- C. Install diffusers, registers, and grilles level and plumb.
- D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure

drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

- A. Refer to Drawings.

END OF SECTION 23 37 13

SECTION 23 37 23 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Dryer vent roof cap
 - 2. Roof mounted intake hood
 - 3. Roof mounted relief hood
- C. Related Sections:
 - 1. Section 23 31 00 - HVAC Duct and Casings: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork, and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.
- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Ventilators shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS.

2.1 DRYER VENT ROOF CAP

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
- B. Unit shall be a spun aluminum, roof mounted gravity ventilator.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of

minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories: Gravity actuated back-draft damper with adjustable counterweight.

2.2 ROOF MOUNTED INTAKE HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Unit shall be an aluminum roof mounted intake hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Birdscreen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be low voltage for control wiring from DDC controller. Damper shall include integral end switch.

2.3 ROOF MOUNTED RELIEF HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Unit shall be an aluminum roof mounted relief hood.

- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Bird screen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Gravity actuated back-draft damper with adjustable counterweight.
 - 2. Motorized damper: actuator shall be low voltage for control wiring from DDC controllers. Damper shall include integral end switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed, and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure intake/relief hoods with cadmium plated steel lag screws to roof curb structure.
- B. Install dampers in roof curb damper tray.
- C. Provide hinged curb adapter to permit access to dampers and duct connection.
- D. Install safety screen where inlet or outlet is exposed.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one (1) day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.4 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.5 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.6 PROTECTION OF FINISHED WORK

- A. Do not operate until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 37 23

SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Category IV Condensing Appliance double wall metal vents.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers and supports for placement by this section.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances.
 - 2. UL 378 - Draft Equipment.
 - 3. UL 441 - Gas Vents.
 - 4. UL 641 - Type L Low-Temperature Venting Systems.
 - 5. UL 959 - Medium Heat Appliance Factory Built Chimneys.

1.4 DESIGN REQUIREMENTS

- A. Design refractory lined metal stacks for wind loading of 110 mph.

1.5 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. **Flue pipe shall be provided and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.**
- C. Manufacturer shall provide a 1/4" = 1'-0" scaled drawing within submittal showing flue pipe routing in plan and elevation views. Drawing of flue routing must be provided with dimensions showing code required distances away from intake hoods, intake louvers, etc. Include dimensions from finished roof to top of flue. Flue gasses discharged must not recirculate back into building by winds or inadequate spacing between any building envelope intakes.
- D. Product Data: Submit data indicating factory-built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics, and connection requirements.

- E. Product Data: Submit data on draft fans and accessories including fan curves with specified operating point plotted, power, RPM, and electrical characteristics and connection requirements.
- F. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. All products furnished under this Section shall conform to the requirements of NFPA-211. Products shall be listed to UL-103 and shall carry the appropriate UL and cUL listing mark or label.
- B. Flue pipe shall be provided and submitted by boiler manufacturer submitting on project.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Maintain water integrity of roof during and after installation of chimney or vent.

PART 2 - PRODUCTS

2.1 CATEGORY IV CONDENSING APPLIANCE DOUBLE WALL METAL VENTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Metal-Fab
 - 2. Heat-Fab
 - 3. Simpson Dura-Vent
 - 4. Ampco
- B. Fabrication: Inner pipe of sheet AL29-4C and outer pipe of 430 stainless steel, tested in compliance with UL 441.
- C. All products furnished under this Section shall conform to the requirements of The National Fuel Gas Code, NFPA-54; and NFPA-211, the Standard for Positive Pressure Condensing Appliances. Products shall be listed to UL-441 and shall carry the appropriate UL or cUL listing mark or label.
- D. The vent shall be of the double-wall, factory-built type for use with approved Category IV condensing appliances burning natural or LP gas, which produce flue gases exhausted at temperatures not exceeding 550° F.
- E. The vent shall be constructed of an outer wall of 430 stainless steel, .018" thick for sizes 3" to 14" diameter, and .024" thick for sizes 16" to 30" diameter. The inner wall shall be constructed of AL29-4C, .035" thick for sizes 3" to 8" diameter and .048" thick for sizes 10" to 30" diameter. The vent shall include an integral, annular insulating air space, 1/4" thick for sizes 3" to 6" diameter and 1/2" thick for sizes 7" to 30" diameter.

- F. Edges of inner and outer walls shall be sealed and joined according to manufacturer installation instructions.
- G. All fittings, flashing, storm collar, cap, and appliance adapter required to install the vent shall be included.
- H. Vent shall be tested and listed for a minimum clearance to combustibles of 1" for sizes 3" to 24" diameter and 2" for sizes 26" to 30" diameter.
- I. Vent shall terminate as required by code.
- J. Vent shall be installed in accordance with the vent manufacturer's installation instructions, UL listing and state or local codes.
- K. Warranty: Furnish 1-year manufacturer warranty for manufactured units to begin at substantial completion.
- L. Accessories, UL labeled:
 - 1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
 - 2. Stack Cap: Consists of conical rain shield with inverted cone for partial rain protection with low flow resistance.
 - 3. Exterior pipe and fittings shall be constructed entirely of type 304 stainless steel.
- M. Application: Category IV Condensing Gas Appliances.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

3.2 INSTALLATION - GENERAL

- A. Install in accordance with NFPA 54.
- B. Install breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- C. All double wall gas vents maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories for complete installation.
- D. Install vent dampers, locating close to draft hood collar, and secured to breeching.
- E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- F. Level and plumb chimney and stacks.
- G. Clean breeching, chimneys, and stacks during installation, removing dust and debris.

- H. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.
- I. Provide the appropriate and/or applicable chimney system continuous from appliances.

3.3 BOILER STACK

- A. Installation shall conform to the manufacturer's installation instructions, UL listing and state or local codes.
- B. Support system from building structure using rigid structural shapes for attachment of fixed point supports (Plate Support Assembly). Anchor supports to structure by welding to inserts, bolting, steel expansion anchors or concrete inserts. Size of structural shapes shall be in accordance with manufacturer's recommendations.
- C. Protect incomplete installations by attaching temporary closures over open ends of sections.
- D. Clean all system sections of dust and debris prior to final connection to appliances.
- E. Maximum unsupported horizontal spacing shall be nine (9) feet between guides.
- F. Maximum unsupported vertical spacing shall be 19 feet between guides.
- G. Pipe to be routed to minimize flow resistance.
- H. Provide double wall bellows joint between each support and for every three (3) inches of expected expansion.
- I. Provide support at roof penetration to support free standing of exhaust above roof and to keep stack centered in ventilated thimble assembly.
- J. Provide drain bucket at bottom of vertical stack, piped to nearest floor drain.
- K. Provide ventilated thimble and storm collar at roof penetration.
- L. Provide flip top fitting at stack termination or engine exhaust.
- M. Provide stack cap on boiler stack termination.

END OF SECTION

SECTION 23 52 16 - CONDENSING BOILER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Heating water boiler heat exchanger.
 - 2. Boiler control panel.
 - 3. Hot water boiler trim.
 - 4. Natural gas fired burner.
- B. Boiler shall be completely factory assembled and tested on a structural steel base and be ready for water, gas, and electric connections.
- C. Boiler and all components shall be CSA certified.
 - 1. ASME Section IV (Heating Boilers)
 - 2. ANSI Z21.13 / CSA 4.9 (Gas Fired Low Pressure Boilers)
 - 3. NFPA 54 (ANSI Z221.3) National Fuel Gas Code
 - 4. ASME CSD-1 (Controls and Safety Devices)
- D. Related Sections:
 - 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolators for placement by this section.
 - 2. Section 23 11 23 - Gas Piping: Execution requirements for gas piping connections to boilers specified in this section.
 - 3. Section 23 51 00 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to boilers specified in this section.
 - 4. Division 26 - Wiring Connections: Execution requirements for electric connections to boilers specified in this section.

1.3 REFERENCES

- A. ASME Section IV (Heating Boilers)
- B. ANSI Z21.13/CSA 4.9 (Gas Fired Low Pressure Boilers)
- C. NFPA 54 (ANSI Z221.3) National Fuel Gas Code
- D. ASME CSD-1 (Controls and Safety Devices)

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.

- B. Flue pipe as specified per 23 51 00 Breechings, Chimneys, and Stacks, shall be provided and submitted by boiler sales representative submitting on project. Flue pipe shall not be submitted separately by a third party, sheet metal contractor, mechanical contractor, etc.; no exception. Flue piping shall be submitted concurrently, but separately, at the same time as boilers.**
- C. Product Data: Submit capacities and accessories included with boiler. Include general layout, dimensions, size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.
- D. Test Reports: Indicate boilers meet or exceed specified performance and efficiency. Submit results of combustion test.
- E. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Manufacturers Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.6 QUALITY ASSURANCE

- A. Conform to ASME Section IV for construction of boilers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.
- B. Gas Train and Safety Controls: Industrial Risk Insurers.
- C. Unit Certification: CSA certified.
- D. Boilers shall comply with 2012 International Energy Conservation Code.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Boilers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If

protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 WARRANTY

- A. The boiler manufacturer shall provide an entire boiler parts and labor warranty (including circulating pump) for a period of one (1) year. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or startup will not be accepted.
- B. Provide an extended parts and labor warranty for the following:
 - 1. Burner and Heat Exchanger: Five (5) years from date of substantial completion.
 - 2. Thermal shock: Ten (10) years from date of substantial completion.
- C. In addition to entire parts and labor warranty, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, and any expenses related to service calls required to diagnose and correct warranty issues.
- D. The manufacturer shall provide factory certificates for each boiler listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- E. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.10 GENERAL

- A. Each factory "packaged" boiler shall be complete with all components, accessories, and appurtenances necessary for a complete and operable boiler as hereinafter specified. Each unit shall be furnished factory assembled with required wiring and piping as a self-contained unit. Each unit shall be readily transported and ready for installation.
- B. Each factory "packaged" boiler, including pressure vessel, trim, valve trains, burner, control system, and all related components, accessories and appurtenances as herein specified shall all be assembled and furnished by the boiler manufacturer. The boiler manufacturer shall provide unit responsibility for the engineering, coordination, workmanship, performance, warranties, and all field services for each factory "packaged"

boiler as specified herein. The boiler manufacturer shall be fully responsible for all components assembled and furnished by him whether or not they are of his own manufacture.

PART 2 – PRODUCTS

2.1 CONDENSING WATER BOILERS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. RBI: Flexcore
 - 2. Camus: Avenger
- B. Each boiler shall be capable of operating continuously at rated capacity while maintaining a CSA certified efficiency of not less than 97 % on 500 MBH input boilers and less and not less than 97% on larger than 500 MBH input boilers. Each boiler shall be capable of operating with a minimum outlet water temperature of 68° F.
- C. Boiler shall comply with ASME Section IV for 80 psig, max 200° F (100 psig on 1500 MBH and larger units).
- D. Fuel shall be natural gas with an assumed higher heating value of 1,030 Btu/Cu Ft and an assumed specific gravity of 0.60 (relative to air). Natural gas shall be supplied at a pressure of no less than 3.5 in.wc. to the inlet gas valve. Maximum inlet gas pressure shall not exceed 14 in.wc.

2.2 BOILER DESIGN

- A. Each hot water boiler shall consist of a stainless-steel primary only heat exchanger complete with trim, valve trains, burner, and boiler control system. The boiler manufacturer shall fully coordinate the boiler as to the interaction of its elements with the burner and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified. Boilers requiring a secondary heat exchanger (economizer) to achieve condensing operation will not be permitted as well as copper-finned heat exchangers.
- B. Each boiler heat exchanger shall be stainless-steel or cast iron, counter-flow design for maximum heat transfer with the multiple sections arranged in a reverse return configuration to assure balanced flow through each section.
- C. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.
- D. All boiler pressure parts shall be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code, Section IV, and shall be so stamped.
- E. Boiler heat exchanger headers shall be fabricated steel and be completely removable for inspection. Seals shall be EPDM, rated for 400 deg F service. Push nipples or gaskets between the sections are not permitted.
- F. Boiler shall be enclosed with a single wall outer casing. It shall be fabricated from minimum 16-gauge carbon steel. The front and top wall shall be secured in place with ¼ - 20 NC bolts (sheet metal screws are not acceptable). The complete outer casing shall be finished, inside and out, with a powder coat finish. The composite structure of the boiler combustion chamber, insulating air gap and outer casing shall be of such thickness and

materials to assure an outer casing temperature of not more than 50°F above ambient temperature when the boiler is operated at full rated load.

- G. An observation port shall be located on the boiler to allow for observation of the burner flame.
- H. Flue gas outlet shall be located on the rear of the boiler. Boiler to be certified for installation with Category IV venting (stack) as defined in NFPA 54 (ANSI Z221), latest edition. Contractor must provide venting (stack) certified for installation on a Category IV appliance.

2.3 BOILER TRIM

- A. Each boiler shall be provided with all necessary trim. Boiler trim shall be as follows:
 - 1. Safety relief valve shall be provided in compliance with the ASME code. Contractor to pipe to acceptable drain.
 - 2. Water pressure-temperature gauge.
 - 3. Primary low water flow fuel cutoff (probe type with manual reset).
 - 4. Manual reset high limit water temperature controller.
 - 5. Operating temperature control to control the sequential operation of the burner.

2.4 BOILER FUEL BURNING SYSTEM

- A. The boiler manufacturer shall furnish each boiler with an integral, power type, straight gas, fully automatic fuel burner. The fuel burner shall be an assembly of gas burner, combustion air blower, valve train, and ignition system. The burner manufacturer shall fully coordinate the burner as to the interaction of its elements with the boiler heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance as specified.
- B. Each burner shall be provided with an integral gas firing combustion head.
- C. Each burner shall provide adequate turbulence and mixing to achieve proper combustion without producing smoke or producing combustibles in the flue gases.
- D. Each boiler shall be provided with an integral variable speed power blower to premix combustion air and fuel within the blower. The combustion air blower shall have sufficient capacity at the rated firing rate to provide air for stoichiometric combustion plus the necessary excess air. Static and total pressure capability shall comply with the requirements of the boiler. The blower shall be a maximum of 900 watts and operate at 6,000 RPM maximum without undue vibration and noise and shall be designed and constructed for exposure to temperatures normal to its location on the boiler. The operating fan speed will be tachometer sensed and be capable of being displayed at the LED display.
- E. Each burner shall of the radial-fired (down-fired) type and constructed of steel with a stainless-steel inner and stainless-steel mesh outer screen.
- F. Each boiler shall be provided with a "Full Modulating" firing control system whereby the firing rate is infinitely proportional at any firing rate between 20% and 100% as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

- G. The Microprocessor shall use a Proportional Integral Algorithm to determine the firing rate. The control must have the following capabilities:
1. Maintain single set point
 2. Reset the set point based on outdoor air temperature.
 3. Boiler shutdown based on outdoor air temperature.
 4. Internal dual set point program with an external switchover. (e.g. - night setback w/external clock, supplied by others)
 5. Alarm relay for any for any manual reset alarm function.
 6. Programmable Low Fire Delay to prevent short cycling based on a time and temperature factor for release to modulation.
 7. LED Display showing current supply and return temperatures, current set points as well as differential set points. It must also display any fault codes whether automatically reset or manually reset.
 8. Local Manual Operation.
 9. Remote Control System (Building Management / Sequencer Control) - The boiler control shall be capable of accepting a 0 -10vdc remote external analog signal to control the firing rate.
 10. Computer (PC) interface for programming and monitoring all functions

2.5 MAIN GAS VALVE TRAIN

- A. Each boiler shall be provided with an integral main gas valve train. The main gas valve trains shall be factory assembled, piped, and wired. Each gas valve train shall include at least the following:
1. Two (2) safety shutoff valves. Valves equipped with dual solenoids that can independently energized for leak testing.
 2. Air – Gas ratio control (maximum inlet pressure 14 in.wc.)
 3. One (1) low gas pressure switch (manual reset).
 4. One (1) high gas pressure switch (manual reset).
 5. Two (2) pressure test ports.

2.6 IGNITION SYSTEM

- A. Each boiler shall be equipped for direct spark ignition.

2.7 COMBUSTION AIR CONTROL

- A. Each boiler shall be provided with an integral combustion air control system. The combustion air system shall be factory assembled. Each combustion air control system shall include at least the following:
 - 1. The primary control shall vary the speed of the blower based on load demand. The blower shall apply a varying negative pressure on the gas valve which will open or close to maintain zero pressure at the valve orifice, thereby increasing or decreasing the firing rate. Both the air and gas shall be premixed in the blower.
 - 2. One (1) low airflow differential pressure switch to ensure that combustion air is supplied.
 - 3. High exhaust back pressure switch

2.8 BURNER CONTROL SYSTEM

- A. The control system shall be supplied with a 24 VAC transformer (120 VAC, single phase, 60 hertz primary). The 120/1/60 power supply to each boiler shall be protected by a 15 Amp circuit breaker located in the MCC (supplied by contractor).
- B. The boiler shall include an electric spark ignition system. Main flame shall be monitored and controlled by flame rod (rectification) system.
- C. Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.
- D. Each boiler control system shall provide timed sequence pre-ignition air purge of boiler combustion chamber. The combustion airflow sensor shall monitor and prove the airflow purge.

2.9 BURNER CONTROL PANEL

- A. The boiler manufacturer shall provide each boiler with an integral factory prewired control panel. The control panel shall contain at least the following components, all prewired to a numbered terminal strip:
 - 1. One (1) burner "on-off" switch.
 - 2. One (1) electronic combination temperature control, flame safeguard and system control.
 - 3. Control circuit breaker, 5 amp
 - 4. All necessary control switches, pushbuttons, relays, timers, terminal strips, etc.
 - 5. LED Display Panel to adjust set points and control operating parameters. LED display to indicate burner sequence, all service codes (0-65), fan speed, boiler set point, and sensor values such as inlet, outlet, flue gas and outdoor air.

2.10 BUILDING AUTOMATION SYSTEM INTERFACE:

- A. Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. A BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed locally at boiler control panel shall be available through building automation system.

2.11 FACTORY TESTING – HYDROSTATIC

- A. Each factory "packaged" boiler shall be hydrostatically tested and bear the ASME "H" stamp.

2.12 FACTORY TESTING – FIRE TESTING

- A. Each factory "packaged" boiler shall be fire tested. The boiler manufacturer shall perform this fire test under simulated operating conditions, with the boiler attached to a working chimney system and with water circulating through the boiler. The manufacturer shall provide a fire test report, including fuel and air settings and combustion test results permanently affixed to the boiler.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install boilers plumb and level, to plus or minus 1/16 inch over boiler base. Stacking of boilers is unacceptable.
- B. Maintain manufacturers recommended and code minimum clearances around and over boilers.
- C. Install boiler on concrete housekeeping pad, minimum four (4) inches high and six (6) inches larger than boiler base on each side. Refer to Section 23 05 29 - Hangers and Supports For HVAC Piping and Equipment.
- D. Install boiler on vibration isolators in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- E. Connect natural gas piping in accordance with NFPA 54.
- F. Connect natural gas piping to boiler, full size of boiler gas train inlet. Arrange piping with clearances and unions for burner removal and service.
- G. Connect hot water piping to supply and return boiler connections.
- H. Install the following piping accessories. Refer to Section 23 05 19 - Meters and Gages For HVAC Piping.
 1. On supply:
 - a. Thermometer well for temperature controller.
 - b. Thermometer well and thermometer.
 - c. Well for control system temperature sensor.
 - d. Strainer.
 - e. Nipple and flow switch.

- f. Pressure gage.
 - g. Shutoff valve.
- 2. On return:
 - a. Thermometer well and thermometer.
 - b. Well for control system temperature sensor.
 - c. Pressure gage.
 - d. Shutoff valve.
 - e. Balancing valve.
- I. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23 - Gas Piping.
 - 1. Strainer.
 - 2. Pressure gage.
 - 3. Shutoff valve.
 - 4. Check valve.
 - 5. Pressure reducing valve.
 - 6. Unions.
- J. Install discharge piping from relief valves and drain valves to nearest floor drain.
- K. Install boiler trim and accessories furnished loose for field mounting.
- L. Install electrical devices furnished loose for field mounting.
- M. Install control wiring between boiler control panel and field mounted control devices.
- N. Connect flue to boiler outlet, full size of outlet.
- O. Route each gas trim vent, separately, to the outdoors. Vent lines sizes shall be a minimum the equivalent size pipe connection. Provide union at each device to facilitate change-out and in the vertical to allow the burner door to swing open. Terminate vents a sufficient distance from air intakes, turn down and provide insect screen.
- P. Contractor must, when filling the system, verify that the pH level is maintained between 6.0 and 8.5.

3.2 FIELD QUALITY CONTROL

- A. Perform combustion test including boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent NOx, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.
- B. Arrange with local authorities having jurisdiction for inspection of boiler, piping, and for certificate of operation. Provide written certification from boiler manufacturer that installation is in compliance with manufacturer's written instructions.
- C. Prior to boiler startup, Contractor to inform Owner to have boiler inspector inspect installation for proper installation and submit for State Operating Certificate.

3.3 BOILER INSPECTION REQUIREMENTS

- A. All new boilers, regardless of new construction or renovation of existing systems, are required to receive inspection by a state boiler inspector or their assigned agent prior to any boiler being energized, no exceptions. A boiler requiring inspection is generally defined by the following characteristics.
 - 1. Heat input exceeds 200,000 Btuh.
 - 2. Nominal water-containing capacity exceeds 120 gallons.
- B. As per Boiler Safety Administration Rules, 65.20, The Owner or operator are the only persons that can submit a request for inspection of a boiler by the state or their agent. The inspection agent has at least 30 days to schedule an inspection date with the Owner. During an emergency situation where a boiler is replaced due to mechanical failure of an existing boiler, the agent may grant approval to the Owner to allow startup before inspection but that is at the agent's discretion.
- C. The installing contractor is required to submit the following documents to the Owner before the Owner can submit for state inspection.
 - 1. Contractor shall complete the attached Boiler Inspection Installation Report and notify the district HVAC department personnel in charge of maintaining all inspection certification documentation for the district.
 - 2. Contractor shall submit all manufacturer's cut sheets and product information on boiler being inspected.
 - 3. Hydrostatic test results on boiler being inspected.
 - 4. Contractor shall submit this information to the Owner in a timely manner so the inspection can be scheduled and performed prior to project completion.
- D. As per the Health and Safety Code, Chapter 755, September 1, 2003.
 - 1. Nuclear, high pressure or steam boilers must receive an annual certificate of inspection and an annual external inspection if they meet these characteristics.
 - a. Pressures exceeding 160 psi.
 - b. Temperatures exceeding 250 degrees Fahrenheit
 - 2. Steam heating boilers and hot water heating boilers shall be inspected biennially (every two years) if they meet these characteristics:
 - a. Pressures not exceeding 160 psi.
 - b. Heat input exceeds 200,000 Btuh.
 - c. Water temperature greater than 210 F but not greater than 250 degrees Fahrenheit
 - d. Nominal water-containing capacity exceeds 120 gallons.
 - 3. Hot water supply boilers shall be inspected triennially (every three years) if they meet these characteristics:
 - a. Pressures not exceeding 160 psi.

- b. Heat input exceeds 200,000 Btuh.
- c. Water temperature not exceeding 210 degrees Fahrenheit; or
Nominal water-containing capacity exceeds 120 gallons.

E. Inspection Responsibilities

1. Preparing the boiler for inspection is listed in the Boiler Safety Administrative Rules, Section 65.70.
 - a. Water shall be drawn off and the boiler thoroughly washed.
 - b. All manhole and hand hole plates, washout plugs, and plugs in the water column connections shall be removed as necessary for complete inspection. The furnace and combustion chambers shall be thoroughly cooled and cleaned.
 - c. All grates and internally fired boilers shall be removed.
 - d. Brickwork shall be removed as required by the inspector in order to determine the condition of the boiler, headers, furnace, supports or other parts.
 - e. The pressure gage shall be removed for cleaning of the siphon and testing, if necessary.
 - f. The low water cutoff device shall be dismantled, cleaned, and prepared for inspection.
 - g. Before removing the manhole or hand hole covers and entering any part of the boiler connected to a common header with other boilers any leakage of steam or hot water shall be eliminated. The non return and stop valves must be closed, tagged, and preferably padlocked, and drain valves between the two valves opened. The feed water valves must be closed, tagged, and preferably padlocked. After draining the boiler, the blowdown valves shall be closed and preferably padlocked. Blowdown lines, where practicable, shall be disconnected between pressure parts and valves. All vent and drain lines shall be opened.
 - h. If the boiler is jacketed so that the seams of shells, drums or domes cannot be seen, enough of the jacketing, setting wall, or other form of casing or housing shall be removed to permit inspection to determine the safety of the boiler, provided such information cannot be determined by other means.
2. For initial boiler inspection after installation:
 - a. Once an inspection date has been established between the inspector and Owner, the boiler manufacturer's representative shall be available on-site for boiler inspection.
 - b. The manufacturer's representative shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.

- c. The manufacturer's representative will be responsible to re-assemble boiler back to its original state and then schedule a startup test with the installing contractor and Owner. All product warranties shall begin once startup has been completed and unit is available for use as designed.
- 3. For annual boiler inspection:
 - a. Once an inspection date has been established between the inspector and Owner, the Owner or their assigned contractor shall be available on-site for boiler inspection.
 - b. The Owner or their assigned contractor shall make the boiler available for inspection as per procedures listed above or tests as required by the inspector.
 - c. The Owner or their assigned contractor will be responsible to re-assemble boiler back to its original state and place the boiler in good working condition.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Start-up boilers according to manufacturer's start-up instructions and in presence of boiler manufacturer's representative and Owner's representative. Test controls and demonstrate compliance with requirements. Adjust burner for maximum burning efficiency. Replace damaged or malfunctioning controls and equipment.

3.5 CLEANING

- A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

3.6 DEMONSTRATION

- A. Demonstrate operation and maintenance procedures.
- B. Furnish services for manufacturer's technical representative for one (1) 8-hour day to instruct Owner's personnel in operation and maintenance of boilers. Schedule training with Owner, provide at least seven (7) days notice to Architect/Engineer of training date.

END OF SECTION 23 52 16

EQUIPMENT SHALL BID AS AN ALTERATE

SECTION 23 64 23 - SCROLL WATER CHILLERS AIR-COOLED

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes chiller package, controls and control connections, chilled water connections, starters, and electrical power connections.
- B. Related Sections:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment - Product requirements for Vibration Isolators for placement by this section.
 - 3. Section 23 05 19 Meters and Gages for HVAC Piping: Product requirements for piping specialties for placement by this section.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.
- E. KW/Ton (kW/kW): The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.
- F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

1.4 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 550/590 - Water Chilling Packages Using the Vapor Compression Cycle.

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- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
 - 2. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
- C. American Society of Mechanical Engineers:
 - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. Underwriters Laboratories Inc.:
 - 1. UL 1995 - Heating and Cooling Equipment.

1.5 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Shop Drawings: Indicate components, assembly, dimensions, weights, and loads, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- D. Product Data: Submit rated capacities, specialties and accessories, electrical requirements, and wiring diagrams.
- E. Design Data: Indicate energy input versus cooling load output from 25 to 100 percent of full load at specified and minimum condenser water temperature.
- F. Test Reports: Indicate results of factory performance test.
- G. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- H. Manufacturer's Certificate: Certify products meet or exceed specified requirements including components not produced by manufacturer.
- I. Manufacturer's Field Reports: Submit start-up report for each unit. Indicate results of leak test and refrigerant pressure test.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural supports.
 - 2. Piping roughing-in requirements.
 - 3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.

EQUIPMENT SHALL BID AS AN ALTERATE

- 4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
- B. Certificates: For certification required in "Quality Assurance" Article.
- C. Source quality-control reports.
- D. Startup service reports.
- E. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

1.8 QUALITY ASSURANCE

- A. ARI Certification: Certify chiller according to ARI 550 certification program.
- B. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.
- C. ASHRAE Compliance:
 - 1. ASHRAE 15 for safety code for mechanical refrigeration.
 - 2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1[, as applicable to chiller design]. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.
- F. Comply with NFPA 70.
- G. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Chillers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

EQUIPMENT SHALL BID AS AN ALTERATE

- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- B. If chiller is mounted on structural-steel support structure coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

1.11 WARRANTY

- A. The chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or start up will not be accepted.
- B. Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty for chillers. All chiller components to be included such as but not limited to refrigerant, compressors, motors, starters, variable frequency drives, condenser coils, evaporator coils, fans, controls, and gear assemblies (as applicable) etc. In the event of failure, the chiller manufacturer shall provide a new motor, compressor, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.
- C. In addition to full machine parts, labor and refrigerant, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.
- D. All components replaced through the warranty process shall be new and not used or rebuilt.
- E. The manufacturer shall provide factory certificates for each chiller listing as a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.

EQUIPMENT SHALL BID AS AN ALTERATE

- F. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.12 PREVENTATIVE MAINTENANCE SERVICE

- A. Furnish service and maintenance of chillers for period of five (5) years from Date of Substantial Completion.
- B. At substantial completion, provide owner a schedule of proposed service dates for prior approval. Preventative maintenance shall not be conducted without prior owner approval.
- C. Include, on a quarterly basis, systematic examination, required adjustments, lubrication of unit and controls calibration. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use new parts produced by manufacturer of original equipment.
- D. Provide quarterly inspections, four (4) per year, by factory direct technician. Provide the owner a minimum of one week's notice prior to inspection.
- E. Perform work without removing units from service during building normal occupied hours. Off-line chiller work must be coordinated with Owner.
- F. At no additional cost to owner provide emergency call back service at all hours during this maintenance period.
- G. Maintain locally adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- H. All maintenance work shall be performed by factory direct service technician. Maintenance work shall not be performed by installing mechanical contractor.
- I. Do not assign or transfer maintenance service to agent or subcontractor.
- J. Provide owner a copy on company letterhead neatly typed of each quarterly and annual report after each visit.

PART 2 – PRODUCTS

2.1 SCROLL WATER CHILLERS AIR-COOLED

- A. Acceptable Manufacturers: Subject to compliance with specification and mechanical drawing requirements, provide products by one of the following:
 - 1. **Refer to Specification 01 23 00 Alternates for acceptable manufacturers.**
 - 2. **All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.**
- B. Product Description: Factory assembled and tested, packaged air-cooled liquid chiller consisting of semi-hermetic rotary screw or hermetic scroll compressors, suction gas-cooled compressor motor, condenser coils, evaporator, refrigeration accessories and control cabinet with single point power connection.

EQUIPMENT SHALL BID AS AN ALTERATE

2.2 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - Capacity (tonnage).
 - Entering and leaving water temperature.
 - Flow rate (GPM).
 - Unit Power Supply: Volts / PH / Amps; MCA / MOCP
 - Refrigerant type.
 - Sales Order #.
 - Date of unit manufactured.

2.3 COMPRESSORS

- A. Scroll Compressors:
1. Unit: Direct drive, hermetic, fixed compression, scroll motor-compressor with control panel.
 2. Features: Centrifugal oil pump, sump oil heater, oil level sight glass, oil charging valve, two-point lubrication for each motor bearing, flooded lubrication for journal and thrust bearings, check valve on scroll discharge port.
 3. Motor: Suction-gas cooled hermetically sealed, squirrel cage induction type.
 4. Automatic Capacity Reduction: Electronic logic controller and air temperature sensor controls unit and hot gas bypass regulator valve.
 5. Provide complete refrigerant charge of **R-32** or **R-454B** and oil charge.
- B. Lube oil system shall include filtration devices with proper valves for removal of filter without removal of refrigerant charge.
- C. Ultra Low Sound Compressor Control: Chiller manufacturer shall provide the following attenuation package and meet scheduled maximum A-weighted sound pressure level rating of 70dBA at 30' from the condenser coil side of chiller per AHRI. A complete sound attenuation package shall be provided regardless of if scheduled dBA is met without.
1. Acceptable sound attenuation package manufacturer: BRD-Noise and Vibration Control Inc. (Factory attenuation packages only are not acceptable)
 2. Complete Ultra-low sound package shall be manufactured by BRD – Noise and Vibration Control, Inc., Hushcore™ Product line, no exceptions.
- Contact: Kristopher Gonzalez – (610) 881-449020**
3. Provide ultra-low sound blanket on a minimum of 100% coverage of each compressor, suction line, discharge line and oil separator: no exceptions.

EQUIPMENT SHALL BID AS AN ALTERATE

4. Removable Sound Covers shall be constructed with a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.³ density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with "D" rings and Velcro™ fasteners. The inner and outer jackets shall protect against UV rays, oil, and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified chiller. Stainless steel wire tie fastening assemblies are not acceptable.
5. Provide detailed ultra-low sound acoustical data with submittal, no exceptions. Data shall include sound pressure rating across each octave band and A-weighted average for chiller as built with attenuation package.

2.4 EVAPORATOR

- A. The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates. Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor.
- B. Furnish multiple refrigerant circuits on multiple compressor units. Include a minimum of two (2) circuits.
- C. Design, test, and stamp refrigerant side for 445 psig working pressure and water side for 150 psig working pressure, in accordance with ASME Section VIII.
- D. Insulate with 0.75-inch minimum thick, closed cell foam, vapor barrier insulation with a maximum K factor of 0.26. This insulation shall have a 3mm thick PE embossed film to provide additional damage resistance as well as be UV resistant. Provide heater plate with thermostat to protect evaporator from freezing down to -20° F. ambient. This heater shall be field powered separate from main unit power by the 120V control circuit connection.

2.5 CONDENSER COILS, FANS AND MOTORS

- A. Coils shall be microchannel and shall have a series of flat tubes containing a series of multiple parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion resistant coating. Tubes shall be cleaned, dehydrated, and sealed. Assembled condenser coils shall be pressure tested at the coil factory at 660 psig and subsequently shall be leak tested at 145 psig ±5 psig and pressure tested at 350 psig at final unit assembly.
- B. Louvered/Wire Panels: Factory installed louvered panels on external condenser coil faces, painted to match unit panels. Factory louvered panels around the base and ends of the machine to restrict unauthorized access.
- C. Low Sound Fans: Reduced rpm, vertical direct driven propeller type condenser fans with fan guard on discharge. Fans shall have a minimum of 7 polymer blades with baffling. Metal blade fans are not acceptable.
- D. Fan Motors: High efficiency 8-pole low RPM motor, direct drive fan connection, 3 phase power, insulation class "F", current protected, Totally Enclosed Air-Over (TEAO) with double sealed, permanently lubricated ball bearings.

EQUIPMENT SHALL BID AS AN ALTERATE

2.6 SOUND RATINGS

- A. Noise Rating: Emitted A-Weighted Sound Pressure Level shall not exceed 71 dBA at 30 feet from sides of the unit when measured according to ARI STANDARD 575.
- B. Acoustic sound compressor blankets and Low Sound Fans shall be provided regardless of if scheduled dBA is met without.

2.7 REFRIGERANT CIRCUIT

- A. Dual refrigerant circuits with one compressor per circuit.
- B. Furnish for each refrigerant circuit:
 - 1. Liquid line solenoid valve.
 - 2. Filter dryer (replaceable core type without refrigerant loss or removal).
 - 3. Liquid line sight glass and moisture indicator.
 - 4. Electronic expansion valve.
 - 5. Charging valve.
 - 6. Insulated suction line.
 - 7. Discharge line check valve.
 - 8. Compressor discharge service valve.
 - 9. Pressure relief device.
 - 10. Oil separator.

2.8 CONTROLS

- A. Factory mounted watertight steel control cabinet containing contactors, power and control wiring with factory wired single point power connection and non-fused disconnect switch with handle extending through face of cabinet. Control cabinet shall include microprocessor-based control system. System shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays, and switches. Control panel shall include LCD display with keypad interface. Display messages shall be plain English. A coded two- or three-character display is unacceptable.
- B. Control Panel shall be NEC409 and UL508A compliant (high short circuit current rating).
- C. Chiller manufacturer shall provide a BACnet interface card (gateway) in control panel. Mounting, wiring, programming, and calibration of gateway shall be provided by chiller manufacturer. Chiller supplier shall provide BAS contractor with point list and programming information as needed.
 - 1. A BACnet communication network interface card with building automation system shall enable building automation system operator to remotely control and monitor the chiller from an operator workstation. Control features available, and monitoring points displayed, locally at chiller control panel shall be available through building automation system.
- D. Gateway shall include the following communication ports: One Ethernet port, one serial port configurable for EIA-232 or EIA-485 and one EIA-485 serial port.
- E. Gateways that transfer data in proprietary language are not acceptable.

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- F. Gateway shall support open protocol communication for data sharing, alarm and event management, scheduling, trending and device and network management.
- G. Furnish the following safety control with indicating lights arranged so machine is shut down and requires manual reset.
 - 1. High condenser refrigerant pressure.
 - 2. Low oil pressure.
 - 3. High oil temperature.
 - 4. High motor current.
 - 5. High motor temperature.
 - 6. Low refrigerant (evaporator) pressure.
 - 7. High bearing temperature.
- H. Furnish the following safety controls. Operating any one control shuts down machine:
 - 1. Low chilled water temperature.
 - 2. Chilled Water Integral flow switches within chiller. Flow proving switches shall be thermal dispersion type (IFM U 40100 or approved equal). Switches shall be U.L. listed, SPDT snap-acting, and pilot duty rated (125 VA minimum). Flow switch shall have relay output, wire break output and temperature output. Flow switch shall be redundant; control contractor to provide flow switch within piping.
 - 3. Loss of an electrical phase.
- I. Furnish manual machine off-auto switch on control panel and the following manual or menu driven software display.
 - 1. Oil pump switch.
 - 2. Machine selector switch to allow load, unload and hold or automatic operation.
 - 3. Manual Set Point Adjustments:
 - a. Leaving chilled water temperature.
 - b. Current demand limit.
 - 4. Status display:
 - a. Chilled water flow proven.
 - b. Cooling required.
 - 1. Unit running.
 - 2. Unit loading.
 - 3. Unit unloading.
 - 4. Manual reset required.
 - 5. Remote chilled water set point active.
 - 6. Remote current water set point active.
 - 5. Set point and Temperature Display:
 - a. Chilled water set point.
 - b. Current limit set point.
 - c. Entering evaporator water temperature.
 - d. Leaving evaporator water temperature.
 - e. Entering condenser water temperature.
 - f. Leaving condenser water temperature.

SCROLL WATER CHILLERS AIR-COOLED

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6. Dial or Electronic Type Pressure Indicators.
 - a. Evaporator refrigerant pressure.
 - b. Condenser refrigerant pressure.
 - c. Low oil pressure (oil sump).
 - d. High oil pressure (oil supply).
- J. Furnish the following operating controls:
 1. Multi-step chilled water temperature controller to cycle compressor and activate capacity controls, with remote thermostat.
 2. Five minute off timer prevents compressor from short cycling.
 3. Periodic pump-out-timer to pump down on chilled water flow and high evaporator refrigerant pressure.
 4. Solenoid valve between heat recovery condenser and receiver to limit refrigerant level in condenser.
 5. Provide low ambient control and high ambient options as required to ensure unit is capable of operation from 0°F to 115°F ambient.
 6. Thermostat to cycle fan motors in response to outdoor ambient temperature.
 7. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
 8. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.
 9. Load limit thermostat to limit compressor loading on high return water temperature.
 10. Three phase monitor to protect unit by stopping compressor on phase loss, phase reversal, phase unbalance, or under voltage.
 11. Provide capacity control system capable of reducing unit capacity to 10% of full load. Compressor shall start in unloaded condition. Application of factory installed hot gas bypass on screw compressors shall be acceptable as required to meet specified minimum load. For scroll compressors, hot gas bypass must be provided and sized for minimum compressor loading on one circuit only. No exceptions.
 12. Cycle counter and operating hour meter.

2.9 MOTOR STARTER

- A. For scroll compressors, furnish across-the-line starter, non-recycling compressor overload, starter relay, and factory mounted control power transformer. Furnish manual reset and current overload protection.

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- B. Design starter enclosure for top or bottom electrical cable entry with front access door. Furnish door with interlock to non-fused disconnect switch. Provide clips to accommodate padlock.
- C. Mount the following devices within enclosure:
 - 1. Non-fused disconnect switch online side with door interlock.
 - 2. Pilot relays to start and stop compressor on signal from chiller control panel.
 - 3. Electronic overload provides overload protection, protects compressor motor from distribution system irregularities, and provides motor current signal to chiller capacity control module.
 - 4. Control power transformer.
 - 5. Fused control circuits for control circuit, oil pump motor, oil heater, and purge control unit.
 - 6. Contactor interlocks for communication between starter and control panel.
 - 7. Capacitors, one for each phase, to correct power factor to minimum 95 percent.
 - 8. Fused disconnect and starter for oil pump-if required.
 - 9. Relay for remote mounted emergency shutdown switch.
- D. Furnish the following devices on starter door or equivalent on unit control panel display:
 - 1. Starter fault trip indicator and reset.
 - 2. Overload trip indicator and reset.
 - 3. Distribution fault trip indicator and reset.
 - 4. Ground fault trip indicator and reset.
 - 5. Ammeters, one for each phase.
 - 6. Voltmeters, one for each phase.

2.10 CHILLER PERFORMANCE

- A. Minimum efficiency shall be per current local adopted IECC Supplement Table.

2.11 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Coordinate voltage with electrical drawings, ensure Overcurrent protective device size and type, and minimum circuit capacity are provided per unit manufacturer's published data.
- B. Factory mounted non-fused molded case disconnect switch.
- C. Single point power connection and grounding lug.
- D. Provide integral 120V control power transformer.

SCROLL WATER CHILLERS AIR-COOLED

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- E. Provide all 120V accessory branch circuits indicated on unit manufacturer's wiring diagram, including separate connection for oil heaters.

2.12 FACTORY CAPACITY TEST

- A. The chiller manufacturer shall provide the necessary special test equipment and services of a factory trained technician to conduct various capacity tests prior to delivery to the project. Tests shall verify and certify that project equipment is in compliance with the Contract Documents.
- B. Four (4) copies of the tests and their results shall be submitted to the Engineer for approval within five (5) calendar days from chiller test date. If test results do not demonstrate compliance with the Contract Documents, the project chillers will be tested with required correction procedures until compliance can be certified.
- C. Conform to UL 1995 code for construction of chillers and furnish UL label.
- D. Conform to ASME Section VIII for construction and testing of chillers.

2.13 PUMPOUT SYSTEM-IF REQUIRED

- A. Provide service valves and connections for refrigerant pump-out to remote storage tank using portable condensing unit. Valves are not required if chiller is capable of pumping the entire refrigerant charge into condenser vessel for storage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install chiller on concrete housekeeping pad minimum four (4) inches high and six (6) inches wider than chiller base on each side. Refer to Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
- B. Install units on vibration isolation. Refer to Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Install chiller accessories furnished loose for field mounting.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between chiller control panel and field mounted control devices.
- G. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit. Refer to Division 26, Electrical.
- H. Provide the following piping accessories on evaporator chilled water piping connections.

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3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.
- B. Install piping from chiller rupture disc to outdoors. Size as recommended by manufacturer. Pipe in accordance with local codes and ASHRAE 15.
- C. Comply with requirements for piping specified in Section 23 21 13 "Hydronic Piping" and Section 23 23 00 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Install piping adjacent to chiller to allow service and maintenance. Piping shall be arranged for easy dismantling to permit tube cleaning. Locate shut-off valves to permit removal of piping for access.
- E. Evaporator Fluid Connections: Connect to evaporator inlet with nipple and flow switch, shutoff valve, Y-strainer, flexible connector, thermometer well for temperature controller, thermometer well and thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with flow switch with DDC interface, shutoff valve, balancing valve, flexible connector, thermometer well and thermometer, thermometer well for temperature controller, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a mechanical coupling manufactured by Victaulic. Refer to Sections 23 05 19 Meters and Gages for HVAC Piping and 23 21 13 Hydronic Piping.
- F. Provide control wiring between chiller control panel and field mounted control devices.
- G. Provide connection to electrical service.

3.3 STARTUP SERVICE

- A. A factory direct authorized service representative shall perform startup service. Chiller startup shall not be performed by contractor.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that refrigerant charge is sufficient, and chiller has been leak tested.
 - 3. Verify that pumps are installed and functional.
 - 4. Verify that thermometers and gages are installed.
 - 5. Operate chiller for run-in period.
 - 6. Check bearing lubrication and oil levels.
 - 7. Verify that refrigerant pressure relief device is vented outside.
 - 8. Verify proper motor rotation.
 - 9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.

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10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
 11. Verify and record performance of chiller protection devices.
 12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- C. Prepare test and inspection startup reports.

3.4 FIELD QUALITY CONTROL

- A. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer's representative shall certify in writing that installation is in compliance with manufacturer's recommendations.
- B. Furnish services of factory trained representative for minimum three (3) days to leak test, refrigerant pressure test, and start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.6 DEMONSTRATION AND TRAINING

- A. Demonstrate system operations and verify specified performance. A functional test of the installed chiller control system shall be performed to demonstrate proper functioning of all interlocks and protective systems specified or otherwise required. This testing shall be conducted in the presence of the Owner's representative and the Engineer. The Contractor shall submit test procedure for approval by the Engineer prior to testing.
- B. Coordinate testing with Testing and Balancing Contractor.

3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean chiller externally and internally to remove foreign material and construction dirt and dust. Clean condensing coils, condensing fans, frame, etc.
- B. **Prior to building occupation, contractor shall clean condenser coils free from dirt and debris.**

END OF SECTION 23 64 23

EQUIPMENT SHALL BID AS AN ALTERATE

SECTION 23 64 27 - ROTARY-SCREW WATER CHILLERS AIR-COOLED

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a complete operational Rotary-Screw Water Chiller.
- B. Related Sections:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 2. Section 23 90 00 "Refrigerant Detection Monitoring System" for refrigerant monitors, alarms, supplemental breathing apparatus, and ventilation equipment interlocks.
 - 3. Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment - Product requirements for Vibration Isolators for placement by this section.
 - 4. Section 23 05 19 Meters and Gages for HVAC Piping: Product requirements for piping specialties for placement by this section.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. COP: Coefficient of performance. The ratio of the rate of heat removal to the rate of energy input using consistent units for any given set of rating conditions.
- C. EER: Energy-efficiency ratio. The ratio of the cooling capacity given in terms of Btu/h to the total power input given in terms of watts at any given set of rating conditions.
- D. IPLV: Integrated part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and referenced to ARI standard rating conditions.
- E. kW/Ton (kW/kW): The ratio of total power input of the chiller in kilowatts to the net refrigerating capacity in tons (kW) at any given set of rating conditions.
- F. NPLV: Nonstandard part-load value. A single-number part-load efficiency figure of merit calculated per the method defined by ARI 550/590 and intended for operating conditions other than the ARI standard rating conditions.

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1.4 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 550/590 - Water Chilling Packages Using the Vapor Compression Cycle.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
 - 2. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
- C. American Society of Mechanical Engineers:
 - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. Underwriters Laboratories Inc.:
 - 1. UL 1995 - Heating and Cooling Equipment.

1.5 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Shop Drawings: Indicate components, assembly, dimensions, weights, and loads, required clearances, and location and size of field connections. Indicate equipment, piping and connections, valves, strainers, and thermostatic valves required for complete system.
- D. Product Data: Submit rated capacities, specialties and accessories, electrical requirements, and wiring diagrams.
- E. Design Data: Indicate energy input versus cooling load output from 25 to 100 percent of full load at specified and minimum condenser water temperature.
- F. Test Reports: Indicate results of factory performance test.
- G. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- H. Manufacturer's Certificate: Certify products meet or exceed specified requirements including components not produced by manufacturer.
- I. Manufacturer's Field Reports: Submit start-up report for each unit. Indicate results of leak test and refrigerant pressure test.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

EQUIPMENT SHALL BID AS AN ALTERATE

1. Structural supports.
 2. Piping roughing-in requirements.
 3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
 4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.
- B. Certificates: For certification required in "Quality Assurance" Article.
- C. Source quality-control reports.
- D. Startup service reports.
- E. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit start-up instructions, maintenance data, parts lists, controls, and accessories. Include trouble- shooting guide.

1.8 QUALITY ASSURANCE

- A. ARI Certification: Certify chiller according to ARI 550 certification program.
- B. ARI Rating: Rate chiller performance according to requirements in ARI 550/590.
- C. ASHRAE Compliance:
1. ASHRAE 15 for safety code for mechanical refrigeration.
 2. ASHRAE 147 for refrigerant leaks, recovery, and handling and storage requirements.
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- E. ASME Compliance: Fabricate and label chillers to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1[, as applicable to chiller design]. For chillers charged with R-134a refrigerant, include an ASME U-stamp and nameplate certifying compliance.
- F. Comply with NFPA 70.
- G. Comply with requirements of UL and UL Canada and include label by a qualified testing agency showing compliance.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Chillers shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water

EQUIPMENT SHALL BID AS AN ALTERATE

migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
- B. If chiller is mounted on structural-steel support structure coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

1.11 WARRANTY

- A. The chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of one (1) year. Warranty shall begin from date of Certificate of Substantial Completion. Provide manufacturer's warranty certificates as described below. Warranty start dates from shipment or startup will not be accepted.
- B. Provide an extended four (4) year FULL machine parts, labor, and refrigerant warranty for chillers. All chiller components to be included such as but not limited to refrigerant, compressors, motors, starters, variable frequency drives, condenser coils, evaporator coils, fans, controls, and gear assemblies (as applicable) etc. In the event of failure, the chiller manufacturer shall provide a new motor, compressor, drive assembly, etc. Local or field rebuilt motors, compressors, drive assemblies etc. are not acceptable.
- C. In addition to full machine parts, labor and refrigerant, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal

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freight/shipping, refrigerant, oils, lubricants, belts, filters, insulation, and any expenses related to service calls required to diagnose and correct warranty issues.

- D. All components replaced through the warranty process shall be new and not used or re-built.
- E. The manufacturer shall provide factory certificates for each chiller listing as a minimum the model, serial number, and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- F. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing mechanical contractor.

1.12 PREVENTATIVE MAINTENANCE SERVICE

- A. Furnish service and maintenance of chillers for period of five (5) years from Date of Substantial Completion.
- B. At substantial completion, provide owner a schedule of proposed service dates for prior approval. Preventative maintenance shall not be conducted without prior owner approval.
- C. Include, on a quarterly basis, systematic examination, required adjustments, lubrication of unit and controls calibration. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use new parts produced by manufacturer of original equipment.
- D. Perform work without removing units from service during building normal occupied hours. Off-line chiller work must be coordinated with Owner.
- E. At no additional cost to owner provide emergency call back service at all hours during this maintenance period.
- F. Maintain locally adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- G. All maintenance work shall be performed by factory direct service technician. Maintenance work shall not be performed by installing mechanical contractor.
- H. Provide quarterly inspections, four (4) per year, by factory direct technician. Provide the owner a minimum of one week's notice prior to inspection.
- I. Do not assign or transfer maintenance service to agent or subcontractor.
- J. Provide owner a copy on company letterhead neatly typed of each quarterly and annual report after each visit.

PART 2 – PRODUCTS

2.1 ROTARY-SCREW WATER CHILLERS AIR-COOLED

- A. Acceptable Manufacturers: Subject to compliance with specification and mechanical drawing requirements, provide products by one of the following:

ROTARY-SCREW WATER CHILLERS AIR-COOLED
23 64 27 - 5

EQUIPMENT SHALL BID AS AN ALTERATE

1. **Refer to Specification 01 23 00 Alternates for acceptable manufacturers.**
 2. **All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.**
- B. Product Description: Factory assembled and tested, packaged air-cooled liquid chiller consisting of semi-hermetic rotary screw or hermetic scroll compressors, suction gas-cooled compressor motor, condenser coils, evaporator, refrigeration accessories and control cabinet with single point power connection.

2.2 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - Capacity (tonnage).
 - Entering and leaving water temperature.
 - Flow rate (GPM).
 - Unit Power Supply: Volts / PH / Amps; MCA / MOCP
 - Refrigerant type.
 - Sales Order #.
 - Date of unit manufactured.

2.3 COMPRESSORS

- A. Rotary Screw Compressor:
1. Semi-hermetic rotary screw compressor with capacity control slide valve, rolling element bearings and differential refrigerant pressure oil pump and oil heater.
 2. Direct drive, constant speed, suction gas-cooled, semi- hermetic motor.
 3. Crankcase heater shall energize when compressor is not running.
 4. Refrigerant used shall be **R-513A**.
 5. Each compressor shall have an isolated refrigerant circuit piped such that burnout of one compressor shall not damage the other compressor(s). Compressors shall not be piped in parallel arrangement into one refrigerant circuit.
- B. Lube oil system shall include filtration devices with proper valves for removal of filter without removal of refrigerant charge.
- C. Ultra Low Sound Compressor Control: Chiller manufacturer shall provide the following attenuation package and meet scheduled maximum A-weighted sound pressure level rating of 70dBA at 30' from the condenser coil side of chiller per AHRI. A complete sound attenuation package shall be provided regardless of if scheduled dBA is met without.

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1. Acceptable sound attenuation package manufacturer: BRD-Noise and Vibration Control Inc. (Factory attenuation packages only are not acceptable)
2. Complete Ultra-low sound package shall be manufactured by BRD – Noise and Vibration Control, Inc., Hushcore™ Product line, no exceptions.

Contact: Kristopher Gonzalez – (610) 881-449020

3. Provide ultra-low sound blanket on a minimum of 100% coverage of each compressor, suction line, discharge line and oil separator: no exceptions.
4. Removable Sound Covers shall be constructed with a Silicone-fiberglass cloth outer jacket, a loaded vinyl barrier septum, fiberglass needle mat (11 lbs./ft.³ density), and a Silicone-fiberglass cloth inner jacket. The covers shall be connected together by means of a cloth straps with “D” rings and Velcro™ fasteners. The inner and outer jackets shall protect against UV rays, oil, and water. Finished Surface Mass – 3 lbs. per sq. ft., to cover compressors and extended components for the specified chiller. Stainless steel wire tie fastening assemblies are not acceptable.
5. Provide detailed ultra-low sound acoustical data with submittal, no exceptions. Data shall include sound pressure rating across each octave band and A-weighted average for chiller as built with attenuation package.

2.4 EVAPORATOR VESSEL

- A. Shell and tube type, seamless or welded steel construction with cast iron or fabricated steel, heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Furnish multiple refrigerant circuits on multiple compressor units. Include a minimum of two (2) circuits.
- B. Design, test, and stamp refrigerant side for 220 psig working pressure and water side for 300 psig working pressure, in accordance with ASME Section VIII.
- C. Furnish water boxes, with tapped drain and vent connections with flanged or mechanical joint connections arranged to permit inspection of tubes from either end without disturbing refrigerant.
- D. Furnish refrigerant chambers with baffles to distribute entering liquid and separate liquid from leaving gas.
- E. Insulate with 0.75-inch minimum thick, closed cell foam, vapor barrier insulation with a maximum K factor of 0.26. This insulation shall have a 3mm thick PE embossed film to provide additional damage resistance as well as be UV resistant. Provide electric resistance immersion heater with thermostat to protect evaporator from freezing down to -20° F. ambient. This heater shall be field powered separate from main unit power by the 120V control circuit connection.
- F. Furnish water drain connection and thermometer wells for temperature controller and low temperature cutout.

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2.5 CONDENSER COILS, FANS AND MOTORS

- A. Coils shall be microchannel and shall have a series of flat tubes containing a series of multiple parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a corrosion resistant coating. Tubes shall be cleaned, dehydrated, and sealed. Assembled condenser coils shall be pressure tested at the coil factory at 660 psig and subsequently shall be leak tested at 145 psig \pm 5 psig and pressure tested at 350 psig at final unit assembly.
- B. Louvered/Wire Panels: Factory installed louvered panels on external condenser coil faces, painted to match unit panels. Factory louvered panels around the base and ends of the machine to restrict unauthorized access.
- C. Low Sound Fans: Reduced rpm, vertical direct driven propeller type condenser fans with fan guard on discharge. Fans shall have a minimum of 7 polymer blades with baffling. Metal blade fans are not acceptable.
- D. Fan Motors: High efficiency 8-pole low RPM motor, direct drive fan connection, 3 phase power, insulation class "F", current protected, Totally Enclosed Air-Over (TEAO) with double sealed, permanently lubricated ball bearings.

2.6 SOUND RATINGS

- A. Noise Rating: Emitted A-Weighted Sound Pressure Level shall not exceed scheduled dBA at 30 feet from sides of the unit when measured according to ARI STANDARD 575.
- B. Acoustic sound compressor blankets and Low Sound Fans shall be provided regardless of if scheduled dBA is met without.

2.7 REFRIGERANT CIRCUIT

- A. Dual refrigerant circuits with one compressor per circuit.
- B. Furnish for each refrigerant circuit:
 - 1. Liquid line solenoid valve.
 - 2. Filter dryer (replaceable core type without refrigerant loss or removal).
 - 3. Liquid line sight glass and moisture indicator.
 - 4. Electronic expansion valve.
 - 5. Charging valve.
 - 6. Insulated suction line.
 - 7. Discharge line check valve.
 - 8. Compressor discharge service valve.
 - 9. Pressure relief device.
 - 10. Oil separator.

2.8 CONTROLS

- A. Factory mounted watertight steel control cabinet containing contactors, power and control wiring with factory wired single point power connection and non-fused disconnect switch with handle extending through face of cabinet. Control cabinet shall include microprocessor-based control system. System shall provide control of chiller operation

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and monitoring of chiller sensors, actuators, relays, and switches. Control panel shall include LCD display with keypad interface. Display messages shall be plain English. A coded two- or three-character display is unacceptable.

- B. Control Panel shall be NEC409 and UL508A compliant (high short circuit current rating).
- C. Chiller manufacturer shall provide a BACnet interface card (gateway) in control panel. Mounting, wiring, programming, and calibration of gateway shall be provided by chiller manufacturer. Chiller supplier shall provide BAS contractor with point list and programming information as needed.
 - 1. A BACnet communication network interface card with building automation system shall enable building automation system operator to remotely control and monitor the chiller from an operator workstation. Control features available, and monitoring points displayed, locally at chiller control panel shall be available through building automation system.
- D. Gateway shall include the following communication ports: One Ethernet port, one serial port configurable for EIA-232 or EIA-485 and one EIA-485 serial port.
- E. Gateways that transfer data in proprietary language are not acceptable.
- F. Gateway shall support open protocol communication for data sharing, alarm and event management, scheduling, trending and device and network management.
- G. Furnish the following safety control with indicating lights arranged so machine is shut down and requires manual reset.
 - 1. High condenser refrigerant pressure.
 - 2. Low oil pressure.
 - 3. High oil temperature.
 - 4. High motor current.
 - 5. High motor temperature.
 - 6. Low refrigerant (evaporator) pressure.
 - 7. High bearing temperature.
- H. Furnish the following safety controls. Operating any one control shuts down machine:
 - 1. Low chilled water temperature.
 - 2. Chilled Water Integral flow switches within chiller. Flow proving switches shall be thermal dispersion type (IFM U 40100 or approved equal). Switches shall be U.L. listed, SPDT snap-acting, and pilot duty rated (125 VA minimum). Flow switch shall have relay output, wire break output and temperature output. Flow switch shall be redundant; control contractor to provide flow switch within piping.
 - 3. Loss of an electrical phase.
- I. Furnish manual machine off-auto switch on control panel and the following manual or menu driven software display.
 - 1. Oil pump switch.
 - 2. Machine selector switch to allow hand, off, or automatic operation.
 - 3. Manual Set Point Adjustments:

ROTARY-SCREW WATER CHILLERS AIR-COOLED

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- a. Leaving chilled water temperature.
 - b. Current demand limit.
- 4. Status display:
 - a. Chilled water flow proven.
 - b. Cooling required.
 - 1. Unit running.
 - 2. Unit loading.
 - 3. Unit unloading.
 - 4. Manual reset required.
 - 5. Remote chilled water set point active.
 - 6. Remote current water set point active.
- 5. Set point and Temperature Display:
 - a. Chilled water set point.
 - b. Current limit set point.
 - c. Entering evaporator water temperature.
 - d. Leaving evaporator water temperature.
 - e. Entering condenser water temperature.
 - f. Leaving condenser water temperature.
- 6. Dial or Electronic Type Pressure Indicators.
 - a. Evaporator refrigerant pressure.
 - b. Condenser refrigerant pressure.
 - c. Low oil pressure (oil sump).
 - d. High oil pressure (oil supply).
- J. Furnish the following operating controls:
 - 1. Multi-step chilled water temperature controller to cycle compressor and activate capacity controls, with remote thermostat.
 - 2. Five minute off timer prevents compressor from short cycling.
 - 3. Periodic pump-out-timer to pump down on chilled water flow and high evaporator refrigerant pressure.
 - 4. Provide low ambient control and high ambient options as required to ensure unit is capable of operation from 0°F to 115°F ambient.
 - 5. Thermostat to cycle fan motors in response to outdoor ambient temperature.
 - 6. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
 - 7. VFD control to vary speed of one at least one condenser fan motor in response to refrigerant condensing pressure.

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8. Load limit thermostat to limit compressor loading on high return water temperature.
9. Three phase monitor to protect unit by stopping compressor on phase loss, phase reversal, phase unbalance, or under voltage.
10. Provide capacity control system capable of reducing unit capacity to 10% of full load. Compressor shall start in unloaded condition. Application of factory installed hot gas bypass on screw compressors shall be acceptable as required to meet specified minimum load. For scroll compressors, hot gas bypass must be provided and sized for minimum compressor loading on one circuit only. No exceptions.
11. Cycle counter and operating hour meter.

2.9 FACTORY MOUNTED VARIABLE FREQUENCY DRIVE (REQUIRED)

- A. VFDs for each compressor shall have a DC link reactor.
- B. All VFDs on the chiller (compressor motors and fans) shall be fully air-cooled and shall not require an additional glycol cooling system. If supplying a VFD glycol cooling system, the following must be provided in conjunction with and for the duration of the service/maintenance agreement specified in section 23 64 27 – 1.12.
 1. Glycol solution replacement every 5 years.
 2. Annual pH test.
 3. Annual fluid level check.
 4. Annual glycol condenser cleaning.

2.10 CHILLER PERFORMANCE

- A. Minimum efficiency shall be per current local adopted IECC Supplement Table.

2.11 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Coordinate voltage with electrical drawings, ensure Overcurrent protective device size and type, and minimum circuit capacity are provided per unit manufacturer's published data.
- B. Factory mounted non-fused molded case disconnect switch.
- C. Single point power connection and grounding lug.
- D. Provide integral 120V control power transformer.
- E. Provide all 120V accessory branch circuits indicated on unit manufacturer's wiring diagram, including separate connection for oil heaters.

2.12 FACTORY CAPACITY TEST

- A. The chiller manufacturer shall provide the necessary special test equipment and services of a factory trained technician to conduct various capacity tests prior to delivery to the

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project. Tests shall verify and certify that project equipment is in compliance with the Contract Documents.

- B. Four (4) copies of the tests and their results shall be submitted to the Engineer for approval within five (5) calendar days from chiller test date. If test results do not demonstrate compliance with the Contract Documents, the project chillers will be tested with required correction procedures until compliance can be certified.
- C. Conform to UL 1995 code for construction of chillers and furnish UL label.
- D. Conform to ASME Section VIII for construction and testing of chillers.

2.13 PUMPOUT SYSTEM-IF REQUIRED

- A. Provide service valves and connections for refrigerant pump-out to remote storage tank using portable condensing unit. Valves are not required if chiller is capable of pumping the entire refrigerant charge into condenser vessel for storage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install chiller on concrete housekeeping pad minimum four (4) inches high and six (6) inches wider than chiller base on each side. Refer to Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
- B. Install units on vibration isolation. Refer to Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Maintain manufacturer's recommended clearances for service and maintenance.
- D. Install chiller accessories furnished loose for field mounting.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between chiller control panel and field mounted control devices.
- G. Provide for connection of electrical wiring between starter and chiller control panel, oil pump, and purge unit. Refer to Division 26, Electrical.
- H. Provide the following piping accessories on evaporator chilled water piping connections.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.
- B. Comply with requirements for piping specified in Section 23 21 13 "Hydronic Piping" and Section 23 23 00 "Refrigerant Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to chiller to allow service and maintenance. Piping shall be arranged for easy dismantling to permit tube cleaning. Locate shut-off valves to permit removal of piping for access.

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- D. Evaporator Fluid Connections: Connect to evaporator inlet with nipple and flow switch, shutoff valve, Y-strainer, flexible connector, thermometer well for temperature controller, thermometer well and thermometer, and plugged tee with pressure gage. Connect to evaporator outlet with flow switch with DDC interface, shutoff valve, balancing valve, flexible connector, thermometer well and thermometer, thermometer well for temperature controller, plugged tee with shutoff valve and pressure gage, and drain connection with valve. Make connections to chiller with a mechanical coupling manufactured by Victaulic. Refer to Sections 23 05 19 Meters and Gages for HVAC Piping and 23 21 13 Hydronic Piping.
- E. Provide control wiring between chiller control panel and field mounted control devices.
- F. Provide connection to electrical service.

3.3 STARTUP SERVICE

- A. A factory direct authorized service representative shall perform startup service. Chiller startup shall not be performed by contractor.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that refrigerant charge is sufficient, and chiller has been leak tested.
 - 3. Verify that pumps are installed and functional.
 - 4. Verify that thermometers and gages are installed.
 - 5. Operate chiller for run-in period.
 - 6. Check bearing lubrication and oil levels.
 - 7. Verify that refrigerant pressure relief device is vented outside.
 - 8. Verify proper motor rotation.
 - 9. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown.
 - 10. Verify and record performance of fluid flow and low-temperature interlocks for evaporator and condenser.
 - 11. Verify and record performance of chiller protection devices.
 - 12. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.
- C. Prepare test and inspection startup reports.

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3.4 FIELD QUALITY CONTROL

- A. Furnish cooling season start-up, winter season shutdown service, for first year of operation. When initial start-up and testing takes place in winter and machines are to remain inoperative, repeat start-up and testing operation at beginning of first cooling season.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer's representative shall certify in writing that installation is in compliance with manufacturer's recommendations.
- B. Furnish services of factory trained representative for minimum three (3) days to leak test, refrigerant pressure test, and start-up, calibrate controls, and instruct Owner on operation and maintenance.
- C. Oil Test: An oil sample shall be taken at start-up from each compressor. Sample will be used as a reference for all warranty oil tests. Oil samples shall be taken annually. The samples shall be tested using the Karl Fisher test method. If test indicates moisture in oil, Contractor shall obtain factory recommended procedure to fix problem. Procedure shall be submitted to Engineer prior to any work being done. All labor and materials for corrective work shall be covered by manufacturer. Oil test shall be analyzed, and report submitted to engineer within 30 days of sample date. Oil samples shall be tested by Analysts Services, Inc., or manufacturer provided testing services.

3.5 DEMONSTRATION AND TRAINING

- A. Demonstrate system operations and verify specified performance. A functional test of the installed chiller control system shall be performed to demonstrate proper functioning of all interlocks and protective systems specified or otherwise required. This testing shall be conducted in the presence of the Owner's representative and the Engineer. The Contractor shall submit test procedure for approval by the Engineer prior to testing.
- B. Coordinate testing with Testing and Balancing Contractor.

3.6 CLEANING

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean chiller externally and internally to remove foreign material and construction dirt and dust. Clean condensing coils, condensing fans, frame, etc.
- B. **Prior to building occupation, contractor shall clean condenser coils free from dirt and debris.**

END OF SECTION

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SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes modular factory fabricated air-handling units and accessories.
- B. Related Sections:
 - 1. Section 23 05 00 - Common Work Results for HVAC.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
 - 3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.
 - 4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
 - 5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
 - 6. Section 23 05 14 - Variable Frequency Controllers.

1.3 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Provide Footprint Square Footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each AHU with corresponding tag.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Product Data, Submit the following:
 - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

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- 3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
- 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.
- 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- F. Manufacturer's Installation Instructions: Submit.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) year's experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

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- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or startup is not acceptable.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "by others".
 - 1. Filters: Furnish three (3) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, and final new set at substantial completion. Filters shall be protected with polyester fabric at all times during construction.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

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PART 2 – PRODUCTS

2.1 MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
- 1. Refer to Specification 01 23 00 Alternates for acceptable manufacturers.**
 - 2. All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.**
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION

- A. Air handling units shall be constructed to fit scheduled maximum dimensions including factory built mixing boxes and must maintain minimum specified access sections as scheduled and shown on plans. Rotating units to different orientations other than what is drawn on plans will be unacceptable. If potentially submitted equipment shall exceed any scheduled dimension, manufacturer shall provide performance data and dimensional data for consulting engineer to review and determine if proposed unit will fit within allotted space and maintain all required maintenance clearance. Equipment with deviations to dimensions shall be submitted 10 days prior to bid date for review.
- B. Outside air / return air mixing boxes shall be factory fabricated with the same construction as the unit casing. Field supplied or installed mixing boxes are not acceptable. Dampers shall be factory installed on mixing box openings. Actuators shall be provided by the control's contractor. This applies to all the air handling units with energy recovery wheel and any unit with outside and return air ducted to the plenum.

2.3 UNIT IDENTIFICATION REQUIREMENTS

- A. Furnish each unit with a durable, deep etched, .025" thick, factory installed aluminum identification plate, permanently mounted with the following information:
- Project name and address.
 - Unit identification as indicated within Contract Documents.
 - Serial Number.
 - Model Number.
 - CFM.
 - Entering and leaving air temperature (DB/WB) (cooling and heating coil).
 - Entering and leaving water temperature (cooling and heating coil).
 - Cooling and heating coil flow rate (GPM).
 - Fan Motor Horsepower.
 - Blower est. ext. sp. (in. wg.).

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- Unit Power Supply: Volts / PH / Amps; MCA / MOCP
 - Sales Order #.
 - Date of unit manufactured.
- B. Custom label shall be provided by and installed at the factory. Label shall not be by a third party or contractor.

2.4 CASING

- A. Base rail shall be a minimum of 14-gauge or heavier G-90 galvanized steel and shall be a minimum of six (6) inches in height. Base assembly shall be thermally broken and insulated with a minimum of 2" thick, R-13 closed-cell sprayed foam. Assemble multiple sections that are shipped loose with gaskets, caulk, and bolts per the manufacturer's installation instructions.
- B. External Casing:
1. Galvanized Steel: 18-gauge G90 with expanded foam injected insulation.
- C. Internal Casing:
1. Galvanized Steel: Solid 18-gauge G90. Provide 20-gauge perforated panels in fan section and discharge plenum.
- D. Casing shall be supported by free-standing 18-gauge G90 structural frame with removable panels. Framing members shall have thermal break and injected with expanded foam insulation. Structural integrity of frame shall not be affected by removing panels. Top, bottom, and side panels shall be of one-piece double-wall construction, formed and reinforced to provide a rigid assembly. All panels shall be completely gasketed at factory with a minimum 1/4-inch-thick x 3/4 inch wide closed-cell neoprene. Top and side panels shall be easily removable for service.
- E. Insulation: Expanded Foam.
1. 'K' (Ksi) factor at 75 degrees Fahrenheit: Maximum 0.154 Btuh inch / sq. ft. / degrees Fahrenheit.
 2. Density: Two (2) inch thick, minimum 1-1/2 lbs. /cu ft. throughout the entire unit. One (1) inch thick casing panels in any section is unacceptable.
 3. Insulation in perforated sections shall be coated on air side to prevent erosion into air stream. Uncoated insulation is unacceptable.
 4. If air unit structural frame comes into contact with conditioned air, it shall be insulated with the same material throughout the rest of the unit.
- F. Access Section: 24" access section with minimum 19" door clearance of double wall galvanized steel construction for flush mounting, with gasket, latch, and handle assembly, same thickness as casing. Access door frame shall be extruded aluminum, foam filled with a thermal break barrier and include a full perimeter automotive style gasket. All access doors shall match unit casing construction, include a thermal break. Provide access section between parallel coil sections, upstream of coil sections, upstream and

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downstream of the energy recovery wheels, in fan sections, filter sections, and mixing boxes. Access doors shall be capable of complete 180° swing.

- G. Cooling Coil Drain Pan: Double wall, Type 304 stainless steel IAQ pan with two (2) inch insulation and welded corners. Drain pans without welded corners are not acceptable. Cross break and pitch to drain connection. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of coil. Intermediate pan shall have a minimum of two drop tubes to main pan. Drain pans shall allow no standing water and comply with ASHRAE Standard 62. Drain pans must be accessible for cleaning.
- H. Strength: Furnish structure to brace casings for suction pressure of five (5) inch wg, with maximum deflection of 1 in 240. Casing deflection shall not exceed a L/240 ratio when subject to an internal pressure of +/- 8-in wg and shall exhibit no permanent deformation at +/- 9-in wg. L is defined as the longest linear panel or cabinet length (measured to AHRI 1350 Cd Level 2).

2.5 FANS

- A. Direct drive plenum fans shall be single width single inlet type with backward inclined airfoil blades. Plenum fan wheel, airfoil blades and hub shall be constructed from welded aluminum.
- B. For fans 4,000 cfm and greater, provide fan wall.**
- C. Fan shall be statically and dynamically balanced at the factory as a complete fan assembly.
- D. The Fan wheels shall be keyed to shaft to prevent slipping.
- E. Construction: AMCA Class II minimum.
- F. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
- G. Sound Ratings: Tested to ARI 260 and label with Certified Sound Rating Seal.
- H. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on slide rails. Furnish access to motor, drive, and bearings through hinged access doors. Mount base on vibration isolators with deflections in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment or 2" deflection, whichever requirement is stricter.
- I. Fan Modulation: Variable Frequency Drives.
- J. Fan Motors: All motors shall be premium efficiency, NEMA MG-1 Section 3, Inverter Duty, Totally Enclosed Fan Cooled (TEFC). Refer to Specification 23 05 13 - Common Motor Requirements for HVAC Equipment for acceptable motor manufacturers.
- K. Flexible Connection: Provide internal flexible connection between fan and air unit casing. Flexible connection between air unit casing and connecting duct shall not be provided when fan is internally isolated with flexible connection to casing.

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2.6 BEARINGS AND DRIVES

- A. Shafts: Solid, hot rolled steel, ground and polished, with keyway, and protectively coated to prevent corrosion.
- B. Motor Shaft Grounding Kit: For all AHU motors connected to a Variable Frequency Drive, a motor shaft grounding kit shall be provided. This shall be factory installed prior to shipment. If not available from the factory, manufacturer is responsible for providing kits and field installation with no additional cost to owner or contractor.
- C. Motor: Motor shall be non-overloading. Motor horsepower shall be sized at a point on fan curve resulting from 105 percent of design RPM at scheduled CFM with a reduction in static pressure of 0.5-inch wg.
 - 1. Motor Enclosure: Totally Enclosed Fan-Cooled (TEFC).
 - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.7 COILS

- A. Provide access doors upstream and downstream of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank-offs and casing sealing grommets at connection penetrations. Coils shall be supported by stainless steel coil support members maintaining a minimum of 1" separation between bottom of coil casing and drain pan.
- B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- C. Water Heating Coils:
 - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 - 2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
 - 3. 18-inch access section between parallel coil faces.
 - 4. Casing: Die formed channel frame 16-gauge type 304 stainless steel.
 - 5. Tubes: 5/8-inch OD seamless copper, 0.020" thick, expanded into fins, brazed joints or 1/2-inch OD seamless copper, 0.025" thick, expanded into fins, brazed joints.
 - 6. Fins: Aluminum, maximum of 11 fins per inch. Minimum fin thickness shall be 0.006" aluminum.

EQUIPMENT SHALL BID AS AN ALTERNATE

7. Coil supports shall be 16-gauge type 304 stainless steel.
- D. Water Cooling Coils:
1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
 3. Coils shall be a maximum of eight (8) rows deep.
 4. 18-inch access section between parallel coil faces.
 5. Casing: Die formed channel frame of 16-gauge type 304 stainless steel.
 6. Drain Pans: Extend 12 inches downstream of coil and for coil banks more than 48 inches high provide intermediate pan with down spouts.
 7. Tubes: 5/8-inch OD seamless copper, 0.020" thick, expanded into fins, brazed joints or 1/2-inch OD seamless copper, 0.025" thick, expanded into fins, brazed joints.
 8. Fins: Aluminum, maximum of 11 fins per inch. Minimum fin thickness shall be 0.006" aluminum.
 9. Coil supports shall be 16-gauge type 304 stainless steel.
- E. Tube Velocities: Coil tube design velocity shall be between 2 feet and 5 feet per second and also maintain design water side temperature difference down to 30 percent flow through coil. Provide tubes that are enhanced internally if minimum initial design tube velocity cannot be obtained.

2.8 AIR FILTRATION

- A. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.
- B. Filter Frames: Filter holding frames shall be permanent metal frames designed to allow replaceable filters to slide into and out of the frame. Frames shall be constructed of 22-gauge, galvanized steel U channel cell sides, expanded metal support grid, 9-gauge hinged retainer gate, wire mesh on the downstream face, sized to fit in standard sized filters, and accept maximum 2" thick media. Acceptable manufacturers: AAF or pre-approved equal.
- C. Replaceable Filter Media: MERV 11 or greater rating in accordance with ASHREA Test Standard 52.2-2007.
- D. High Capacity Angle Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.
- E. Filter Area: Max velocity of 350 FPM.

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- F. Provide a list of each air handling unit with associated filter sizes to owner at substantial completion.

2.9 CONTROLS

- A. Controls: Refer to Section 23 09 23 - Direct-Digital Control System for HVAC.

2.10 CAPACITY

- A. Performance: Provide equipment as scheduled on Drawings.

2.11 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Provide equipment with electrical characteristics as shown on Electrical Drawings.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Requirements for motors.
- C. Section 23 05 14 - Variable Frequency Controllers: Requirements for drives.
- D. Combination Starter-Disconnect Switch: Provided by Division 26.
- E. Junction Box: Factory provided, mounted, and wired junction boxes on each fan section. J-box shall allow electrical contractor to connect power to device without penetrating through cabinet. Field installed J-boxes will not be acceptable; it shall be the complete responsibility of the manufacturer to install. Units shall be shipped with J-boxes pre-wired and mounted. Within equipment submittal the manufacturer shall show J-box location on plan view dimensional drawing.
- F. Combination Variable Frequency Drive-Disconnect Switch & Bypass: Air units that are scheduled to be controlled by a variable frequency drive shall be equipped with a factory provided variable frequency drives in a NEMA 1 enclosure. VFD shall be wall mounted and wired by mechanical contractor. Drives shall be in accordance with specification Section 23 05 14 - Variable Frequency Controllers. Drives shall be provided with Modbus, BACnet or LON Communications protocol as specified in Section 23 05 14 - Variable Frequency Controllers.
- G. All starters shall be equipped with integral phase-failure relay (automatic resetting type) to shut down motor upon loss of an electrical phase.

2.12 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

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- D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with ARI 430.
- B. The mechanical rooms shall be kept broom clean prior to starting any mechanical equipment to minimize dust in the system.
- C. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- D. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases; Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- F. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.
- G. Provide trapped condensation drain line routed to the nearest floor drain. Refer to detail on Drawings and Section 23 21 13 - Hydronic Piping.
- H. Installation of Hot Water Heating and/or Chilled Water Coil:
1. Make connections to coils with unions. Position unions to permit coil removal.
 2. Connect water supply to leaving airside of coil (counter flow arrangement).
 3. Locate water supply at bottom of supply header and return water connection at top.
 4. Install water coils to allow draining and install drain connection at low points.
 5. Install the following piping accessories on piping connections. Refer to Section 23 21 13 - Hydronic Piping.
 - a. On supply: (refer to coil connection details)
 - 1) Thermometer well and thermometer.
 - 2) Well for control system temperature sensor.
 - 3) Shutoff valve.
 - 4) Pressure gage.
 - 5) Strainer
 - b. On return: (refer to coil connection details)

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- 1) Air vent.
 - 2) Thermometer well and thermometer.
 - 3) Well for control system temperature sensor.
 - 4) Pressure gage.
 - 5) Modulating control valve (by BAS).
 - 6) Balancing / shut-off valve with pressure / temperature ports.
6. Install valves and piping specialties in accordance with details as indicated on Drawings.
 7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.
 8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.
- I. Air unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating, and isolators are not short-circuited during operation.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to air-handling unit to allow service and maintenance.
- D. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- E. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- F. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 23 31 13 "Metal Ducts" and Section 23 33 00 "Air Duct Accessories."
- G. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

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1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
 2. Charge refrigerant coils with refrigerant and test for leaks.
 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.4 STARTUP SERVICE

- A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that shipping, blocking, and bracing are removed.
 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 6. Verify that zone dampers fully open and close for each zone.
 7. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.
 8. Comb coil fins for parallel orientation.
 9. Verify that proper thermal-overload protection is installed for electric coils.
 10. Install new, clean filters.
 11. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:

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1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. All air units shall remain in manufacturer's protective shipping wrap during construction. Air unit casing openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

END OF SECTION 23 73 13

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SECTION 23 81 26 - DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS

PART I -GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. Indoor, wall or ceiling mounted, direct-expansion fan coils are matched with cooling only outdoor unit.
- B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only or heat pump system (refer to schedule).
- C. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.
- D. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed locally at fan coil controller shall be available through building automation system.
- E. Outdoor unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC. Units shall be evaluated in accordance with UL standard 1995. Units shall be listed in the CEC directory. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061). Air-cooled condenser coils shall be leak tested at 573 psig.
- F. Provide equipment with electrical characteristics as shown on the Electrical Drawings.

1.3 DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS:

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. **Refer to Specification 01 23 00 Alternates for acceptable manufacturers.**
 - 2. **All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.**

1.4 SUBMITTAL:

- A. Submit in form similar to the schedule on the Drawings. Show all data listed in schedule, electrical characteristics and accessories being provided.

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- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- D. Product Data: Submit product data, including manufacturer's □ product sheet for specified products.

1.5 WARRANTY

- A. One (1) year on unit parts other than compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- B. Five (5) years on compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- C. One (1) year on refrigerant and oil. Warranty shall begin from date of Certificate of Substantial Completion.

PART 2 –PRODUCTS

2.1 UNIT CABINET:

- A. Indoor unit cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.
- B. Outdoor unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
- C. Indoor and outdoor unit shall be of the same manufacturer.

2.2 COMPRESSOR

- A. Compressor shall be fully hermetic rotary type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

2.3 COIL

- A. Evaporator coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.
- B. Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

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2.4 FANS

- A. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

2.5 AIR FILTERS

- A. Unit shall have filter track with factory-supplied cleanable filters.

2.6 BUILDING AUTOMATION SYSTEM INTERFACE:

- A. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62° F to 84°F.
- B. The unit shall have integral controls provided by unit manufacturer to perform input functions necessary to operate the system. Factory installed hardware and software to enable building automation system to monitor, control, and display status and alarms.
 - 1. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed locally at fan coil controller shall be available through building automation system.
 - 2. The unit shall be compatible with interfacing with connection to BACnet networks or interfacing with connection to BMS system.
- C. The unit shall have the following functions as a minimum:
 - 1. An automatic restart after power failure at the same operating conditions as at failure.
 - 2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 - 3. Temperature-sensing controls shall sense return air temperature.
 - 4. Indoor coil freeze protection.
 - 5. Wireless infrared remote control to enter set points and operating conditions.
 - 6. Automatic air sweep control to provide on or off activation of air sweep louvers.
 - 7. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 - 8. Fan-only operation to provide room air circulation when no cooling is required.

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9. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
10. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.
11. Automatic heating-to-cooling changeover in heat pump mode. Control shall include dead band to prevent rapid mode cycling between heating and cooling.
12. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

PART 3 -EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
 2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.2 STARTUP SERVICE

- A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

3.3 CLEANING

- A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 81 26

EQUIPMENT SHALL BID AS AN ALTERNATE

SECTION 23 82 19 - FAN COIL UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes factory fabricated fan coil units and accessories.
- B. Related Sections:
 - 1. Section 23 05 00 - Common Work Results for HVAC.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
 - 3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.
 - 4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
 - 5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
 - 6. Section 23 05 14 - Variable Frequency Controllers.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Provide Footprint Square footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each FCU with corresponding tag.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Product Data, Submit the following:
 - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

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- 3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
- 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.
- 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- F. Manufacturer's Installation Instructions: Submit.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.

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- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- E. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- F. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up is not acceptable.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "by others".
 - 1. Filters: Furnish three (3) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, and final new set at substantial completion. Filters shall be protected with polyester fabric at all times during construction.

1.10 COORDINATION

- A. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

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PART 2 – PRODUCTS

2.2 FAN COIL UNITS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. **Refer to Specification 01 23 00 Alternates for acceptable manufacturers.**
 - 2. **All materials and labor costs to coordinate, receive, install and start-up the equipment per this specification for a complete and operational system shall be included in the Contractor's Base Bid.**
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

2.3 MANUFACTURED UNITS

- A. Fan coil units shall be factory assembled and consist of fans, motor and drive assembly, coils, filters, stainless-steel condensate pans and accessories.

2.4 CABINET

- A. Materials: Formed single-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections gasketed.
 - 1. Outside Casing: 18 gauge, galvanized steel (G90).
 - 2. Utility Lugs: For lifting unit and fastening to permanent structure, 8 gauge, galvanized steel (G90).
- B. Cabinet Insulation: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: Closed cell foam insulation.
 - 2. Thickness: 1 inch.
 - 3. Density: 1 ½ pounds per cubic foot.
 - 4. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - 5. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50, when tested according to ASTM C 411.
- C. Access Panels: Same materials and finishes as cabinet complete with threaded bolted fasteners, and gaskets. Inspection and access panels shall be sized and located to allow periodic maintenance and inspections and include hinged access with lift and turn fasteners on both sides of unit. Provide access panels in the following locations:
 - 1. Fan Section: Double wall hinged access doors.

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2. Coil Section: Inspection panel.
 3. Filter Section: Hinged access doors to allow periodic removal and installation of filters.
- D. Condensate Drain Pans: Formed sections of stainless-steel sheet complying with requirements in ASHRAE 62. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) when units are operating at maximum catalogued face velocity across cooling coil.
1. Double-Wall Construction: Fill space between walls with 1 inch, 1 ½ pound fiber glass insulation.
 2. Drain Connections: Main and auxiliary on same side of fan. Provide auxiliary drain pan connection under unit above ceiling.
 3. Float Switch: Provide a factory installed and wired drain pan float switch.

2.5 FAN SECTION

- A. Fan-Section Construction: Direct drive centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, and support structure and equipped with formed-steel channel base for integral mounting of fan, motor, and casing panels. Mount fan with interior torsion flex mount and exterior spring vibration isolation.
- B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and access panels or doors to allow entry to internal parts and components.
1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Horizontal Flanged Split Housing: Bolted construction.
 3. Drive Frame: Rail mounted, heavy gauge steel to allow frame to slide for easy belt tensioning.
- C. Fan Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower.
- D. Forward-Curved Fan Wheels: Galvanized-steel and/or aluminum/painted steel construction with inlet flange, back plate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically secured to flange and back plate; cast-steel hub swaged to back plate and fastened to shaft with set screws.
- E. Coatings (exterior only): Baked Enamel
- F. Shafts: Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
1. Turned, ground, and polished Stainless steel with keyway. Ship with a protective coating of lubricating oil.

EQUIPMENT SHALL BID AS AN ALTERNATE

2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- G. Pre lubricated and Sealed Shaft Bearings: Bearings shall be ball bearing type (no sleeve bearings allowed), permanently lubricated and sealed for life.
- H. Fan-Section Source Quality Control:
 1. Factory test fan performance for flow rate, pressure, power, air density, rotation speed, and efficiency. Establish ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."
- I. Inlet/outlet duct collars. Galvanized collars at each inlet and outlet of the unit. Flexible duct connection isolating discharge of scroll from discharge of fan.

2.6 MOTORS

- A. General: Comply with requirements in Section 23 05 13 Common Motor Requirements for HVAC Equipment and Division 26. Matched with fan load.
- B. Maximum Ambient Temperature Rating: 120 degrees F (50 degrees C).
- C. Premium efficiency Electronically Commutated (ECM) with thermal overload protection wired to exterior junction box.
 1. Motor size 1/2 HP and 1 HP shall have integrated control module with thermal overload protection. Motor size 1-1/2 HP and 3 HP shall have remote mounted control with thermal overload protection. Motor control module is mounted in cabinet interior.
 2. Motors shall be factory wired to unit control box with quick connect electrical plugs.
 3. Motors shall be RPM controlled, UL Recognized, or equivalent, continuous duty rated.
 4. Motor service access shall be on same side as coil connections.

2.7 COILS

- A. Coil Sections: Common or individual, insulated, galvanized-steel casings for heating and cooling coils. Design and construct to facilitate removal and replacement of coil for maintenance and to ensure full airflow through coils.
- B. Water Coils: Self-draining coil fabricated according to ARI 410.
 1. Piping Connections: Sweat
 2. Tubes: Copper, 0.016 inch tube thickness
 3. Fins: Aluminum, 10 fins per inch
 4. Fin and Tube Joint: Mechanical bond

EQUIPMENT SHALL BID AS AN ALTERNATE

5. Headers: Seamless copper tube with brazed joints
6. Frames: Galvanized-steel channel frame.
 - a. Working-Pressure Ratings: 250 psig, 300 deg F.
7. Source Quality Control: Test to 500 psig underwater (2000 psig ultimate strength).

2.8 FILTER SECTION

- A. Filters: Comply with NFPA 90A.
- B. Filter Section: Provide maximum 2" thick filter holding frames arranged for vertical orientations, with hinged access panels on both sides of unit. Filters shall be removable from both sides.
- C. Extended-Surface, Disposable Panel Filters: Factory-fabricated, dry, extended-surface filters with holding frames.
 1. Media: Fibrous material formed into deep-V-shaped.
 2. Media and Media-Grid Frame: Nonflammable cardboard.
- D. Replaceable Filter Media: MERV 11 or greater rating in accordance with ASHRAE Test Standard 52.2-2007.

2.9 ELECTRICAL

- A. Fan motor shall be wired to an external electrical. Include a motor control board, motor circuit fusing, 24V control circuit transformer, and terminal strip for connection of field wiring.
- B. For Constant Air Volume Fan Systems: Provide a dial potentiometer for manual airflow adjustment during test and balancing.
- C. For Variable Air Volume Fan Systems: Provide a 0-10VDC input for BAS fan speed control.
- D. Provide a single point power connection with factory installed and wired non-fused disconnect switch with lock-out-tag-out ready feature.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with ARI 430.
- B. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

EQUIPMENT SHALL BID AS AN ALTERNATE

- C. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- E. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.
- F. Provide trapped condensation drain line routed to the nearest floor drain. Refer to detail on Drawings and Section 23 21 13 - Hydronic Piping.
- G. Installation of Hot Water Heating and/or Chilled Water Coil:
 - 1. Make connections to coils with unions. Position unions to permit coil removal.
 - 2. Connect water supply to leaving airside of coil (counter flow arrangement).
 - 3. Locate water supply at bottom of supply header and return water connection at top.
 - 4. Install water coils to allow draining and install drain connection at low points.
 - 5. Install the following piping accessories on piping connections. Refer to Section 23 05 19 – Meters and Gages for HVAC Piping.

On supply: (refer to coil connection details)

- 1. Thermometer well and thermometer.
- 2. Well for control system temperature sensor.
- 3. Shutoff valve.
- 4. Pressure gage.
- 5. Y-Strainer

On return: (refer to coil connection details)

- 1. Victaulic / TA 78K (combination balancing / shut-off globe valve with memory stop and pressure / temperature ports).
 - 2. Air vent.
 - 3. Thermometer well and thermometer.
 - 4. Well for control system temperature sensor.
 - 5. Pressure gage.
 - 6. Modulating control valve (furnished and installed by BAS).
 - 7. Shutoff valve.
- 6. Install valves and piping specialties in accordance with details as indicated on Drawings.
- 7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.
- 8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.

EQUIPMENT SHALL BID AS AN ALTERNATE

- H. Fan coil unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating, and isolators are not short circuited during operation.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to low profile fan coil units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans, to drainage piping. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Section 23 21 13 Hydronic Piping. Connect to supply and return coil tapings with shutoff or balancing valve and union or flange at each connection.
- F. Condensate Piping: Comply with applicable requirements in Section 23 21 13 Hydronic Piping. Connect to supply and return coil tapings with shutoff valve and union or flange at each connection.
- G. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 Refrigerant Piping. Connect to supply and return coil tapings with shutoff valve and union or flange at each connection.
- H. Duct installation and connection requirements are specified in Section 23 31 00 HVAC Duct and Casings.
- I. Electrical: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- J. Ground equipment according to Division 26.
- K. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

EQUIPMENT SHALL BID AS AN ALTERNATE

C. Tests and Inspections:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
8. Comb coil fins for parallel orientation.
9. Verify that proper thermal-overload protection is installed for electric coils.
10. Install new, clean filters.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

EQUIPMENT SHALL BID AS AN ALTERNATE

- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

3.8 PROTECTION OF FINISHED WORK

- B. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 23 82 19

SECTION 23 82 39.19 - ELECTRIC UNIT HEATERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electric Unit Heaters.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

1.3 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 - 2. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.
- B. Underwriters Laboratories Inc.:
 - 1. Units to be UL Listed.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Details of anchorages and attachments to structure and to supported equipment.

4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of integral controls.
6. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Suspended ceiling components.
 2. Structural members to which unit heaters will be attached.
 3. Method of attaching hangers to building structure.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Access panels.
 6. Lighting fixtures.
 7. Perimeter moldings for exposed or partially exposed cabinets.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept heaters and controls on site in factory packaging. Inspect for damage.

1.9 WARRANTY

- A. Furnish a five (5) year manufacturer warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start-up will not be acceptable.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Chromalox
 - 2. Markel
 - 3. Modine
 - 4. Reznor
- B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, controls, and accessories complying with ARI 440:
 - 1. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.
 - 2. Control Voltage: 24-volt, 60 hertz
 - 3. Wall mounted adjustable thermostat.
 - 4. Location: Suspended overhead.
 - 5. Comply with UL 2021.
- C. Cabinet: 18-gauge steel with baked enamel finish, easily removed and secured access panels, insulated or double panel construction.
- D. Supply Fan: Propeller type with direct drive, dynamically balanced and mounted with rubber vibration insulators.
- E. Heat Exchanger: High mass, all steel tubular finned type, copper brazed elements.
- F. Controls: Wall mounted Thermostat with fan switch.
- G. Motor: Totally enclosed industrial rated. Motor on units to 20KW shall utilize sealed bearings. Motor on units larger than 20KW shall be 2-speed, permanent capacitor-type, continuous duty.
- H. Wiring:
 - 1. Sub-divided circuits with individual fuse protection
 - 2. Internal 24V control transformer.
 - 3. Heavy duty magnetic contactors.
 - 4. Thermal cutouts on control circuit with automatic reset.

5. Low voltage thermostatic kit with fan switch.
6. Factory wired disconnect switch.
7. Performance: Provide equipment as scheduled on Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Install unit heaters level and plumb.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Comply with safety requirements in UL 1995.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

3.6 DEMONSTRATION

- A.** Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 23 82 39.19

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the national electrical code, and local codes.
- B. All electrical materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.4 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the electrical system components.
- C. Make all electrical connections to all equipment furnished by this division and any other division.
- D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.5 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The

drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.

- B. The Electrical Drawings are necessarily diagrammatic in character and cannot show every connection in detail or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.6 SUBMITTALS

- A. Specification Review:
 - 1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

1.7 EXISTING CONDITIONS

- A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.
- B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.
- C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - EXECUTION

2.1 EXISTING WORK

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction.
- C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.

2.2 OWNER INSTRUCTION

- A. Provide on-site Owner training for all new equipment.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a complete system of building wire and cable to all electrical loads.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Provide stranded conductors for all wiring.
 - 2. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 3. Conductor not smaller than 16 AWG for control circuits.
 - 4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
 - 5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
 - 6. Copper.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN insulation, in raceway.
- C. Branch Circuit Conductors: No branch circuit conductors are allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Southwire
 - 3. General Cable Co.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation: NFPA 70; Type THHN/THWN insulation for feeders and branch circuits.

2.2 TYPE AC CABLE

- A. Manufacturers:
 - 1. AFC
 - 2. Southwire
- B. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.
- C. Comply with NEC 320.
- D. Support, provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.
- E. Provide an insulated green grounding conductor in all Type AC cable.
- F. Acceptable Use: Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.
- G. Provide insulated throat fittings at all terminations of Type AC cable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.

- C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques - Wiring Connections:
1. Clean conductor surfaces before installing lugs and connectors.
 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
 - b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
 - c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)	
<u>System/Phase</u>	A	B	C	N	G	IG
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.
 2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.
 3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
For 6 AWG and smaller: Green.
For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

- A. Limit the number of current carrying conductors per conduit to 6. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.
- B. Grouping of different voltages is not allowed.
- C. Provide metal box sizes per NEC Table 314.16 (A).
- D. Provide conduit per NEC Annex C.
- E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

- A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed in exposed areas in finished spaces and spaces without a ceiling.
- B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet rock, plaster and other "hard" (non-lay-in) ceiling types of construction.
- C. Labeling: Provide label on all junction boxes.
 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system wiring name.

END OF SECTION 23 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.
 - 6. Plate electrode.

1.5 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.

1.6 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 GROUND RING PRE-INSTALLATION MEETINGS

- A. This paragraph shall apply to buildings when a ground ring is specified.
- B. Convene minimum one (1) week prior to commencing work of this section.

- C. Coordinate with concrete pour schedule for footings to insure rebar in concrete is available for bonding.

1.8 MADE ELECTRODE INSPECTION

- A. Convene prior to cover up of work of this section.
- B. Coordinate inspection of made electrode, exothermic welds and test well installation.

PART 2 PRODUCTS

PART 3

3.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. O-Z Gedney Co.
 - 5. Thomas & Betts
 - 6. VFC
- B. Product Description:
 - 1. Material: Copper-clad steel
 - 2. Diameter: 3/4 inch
 - 3. Length: ten (10) feet

3.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: #2 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

3.3 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. ILSCO Corporation
 - 5. O-Z Gedney Co.
 - 6. Thomas & Betts, Electrical
 - 7. VFC
- B. UL Listed for grounding applications.

- C. Provide "ACORN" style ground clamp only for all driven ground rods unless noted to be exothermic connected in this specification. UL listed for connecting ground conductor to a driven ground rod.
- D. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

3.4 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Cadweld by Erico, Inc.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

3.5 GROUNDING BUSSES

- A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
 - 1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
 - 2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
 - 3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
 - 4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
 - 5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
 - 6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Series two (2) inch insulators.
 - 7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
 - 8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, www.harger.com), Erico, Inc. (800-248-9353) or approved equal.

3.6 DRIVEN ELECTRODE ACCESS WELL AND COVER

- A. Eight (12) inch diameter concrete pipe with belled end.
- B. 24 inches long or longer to reach ground and set flush in grade.
- C. Provide cast iron cover with "GROUND" embossed on top.

PART 4 – EXECUTION

4.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

4.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

4.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

4.4 INSTALLATION

- A. Install in accordance with NEC Article 250. Properly bond the system neutral to the system grounding electrode conductor at the main service entrance equipment. Properly maintain the existing neutral-ground bond. Route the grounding electrode conductor to, and bond to, the grounding electrode system. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.
- B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.
- E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.
- F. Transformers: Ground as a separately derived source.
 - 1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.
 - 2. Size bonding jumper per NEC Table 250.66.
 - 3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Concrete-Encased Electrode (NEC 250-52):
 - 1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless otherwise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.

- I. Made Electrode:
 - 1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".
 - 2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
 - 3. Install grounding electrode conductor of 3/0 Copper.
- J. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.
- K. Grounding Busses:
 - 1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
 - 2. Provide in each IDF and MDF room.
 - 3. Provide at each CATV / MATV head-end mounting board.
 - 4. Provide at each building communications rack.
 - 5. Provide at each sound reinforcement equipment rack.
- L. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.
- M. Metal Building Frame NEC 250-52.
 - 1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
 - 2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.
- N. Ground Ring Electrode (NEC 250-52):
 - 1. Provide a tinned, bare copper conductor, size AWG #2 or larger, ground loop in direct contact with the earth. Install around and below the entire periphery of the building at least 36 inches underground. The ring conductor shall be in direct contact with the earth and below any concrete mat or seal slab that may be part of the building structural foundation. Bond this ground ring to all other electrodes and to the grounded service conductor (neutral) in the building main switchboard at a point on the supply side of each service disconnect.
- O. Fuel Gas Piping:
 - 1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuous and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
 - 2. Gas piping shall not be used as a grounding electrode.

- P. Engine Generator Neutral:
 - 1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
 - 2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator.
- Q. Outdoor Lighting Poles:
 - 1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

3.5 OTHER GROUNDING SYSTEMS:

- A. General Check the drawings for special grounding system or grounding requirements.
- B. Telephone and data equipment grounding connections:
 - 1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.
- C. Other Buildings Served From Common Service:
 - 1. The main building service is the source for electric service to several out buildings on site.
 - 2. Isolate neutral bus from ground at each out-building main panel.
 - 3. Provide an equipment grounding conductor in feeder to each out-building main panel.
 - 4. Provide a local building ground rod at each out-building. Bond at least one building column footing to the ground rod.
 - 5. Bond grounding conductor of building main feeder to grounding electrode system established at the particular building.

3.6 EQUIPMENT GROUNDING SYSTEM

- A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.
- B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

- A. Grounding Tests:
 - 1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
 - 2. Provide written test report to document all findings, test values, work done and certification of grounding system.

3. Use true-RMS meters for all voltage and current measurements.
4. Test telecommunications grounding riser to verify continuity.
5. Check all isolated ground receptacles for correct polarity.
6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
8. Verify continuity and isolation of audio system ground bus and grounding riser.
9. Perform ground resistance and continuity testing in accordance with IEEE 142.
10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

3.8 TEST WELLS

- A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
 1. Designated Ground Rods:
 - a. One (1) at triple ground rod for High School Main Switchboard Electrical Room.
 - b. One (1) at each generator.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
 - 4. Appleton
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

- A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.

2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
1. Dow Corning Corp.
 2. Fire Trak Corp.
 3. Hilti Corp.
 4. International Protective Coating Corp.
 5. 3M fire Protection Products .
 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Multiple component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- B. General:
1. Furnish UL Listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- C. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.

- B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
 - 5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
 - 4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.

- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.
- G. Fire Rated Surface:
 - 1. Seal opening at all rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Provide mechanical sleeve seals.
- B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.
- C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

- D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.6 COORDINATION

- A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.
- B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.
- C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.
- D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Multi Cell
 - 7. O-Z Gedney
 - 8. Raco.
 - 9. or approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit

- E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.
- F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.
- G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.
- H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
 - 1. Manufacturer:
 - a. Ocal Inc.
 - b. Perma Cote Industries
 - c. Rob-Roy Industries
 - d. or Approved equal.
- I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.
- J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
 - 1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
 - 2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

2.2 ENCLOSURES

- A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.
- B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.
- C. Construction:
 - 1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
 - 2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
 - 3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
 - 4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. "Quazite" or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to provide a solid bearing surface. Provide a bolted cast iron traffic cover with

foundry-cast marking "Electrical", "Communications" or "Telephone" as applies. Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.3 WIREWAY

- A. Manufacturers: Same as Metal Conduit.
- B. Product Description: General purpose.
- C. Size: As determined by Contractor in accordance with NEC 376.
- D. Cover: Screw cover.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.4 OUTLET BOXES

- A. Manufacturers: Same as Metal Conduit.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer.
- D. Wall Plates: As specified in Section 26 27 26.

2.5 FLOOR BOXES

- A. UL listed for wet application, watertight cast-iron.
- B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
 - 1. Floor: Fully adjustable before and after pour.
 - 2. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
 - 3. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
 - 4. Multi Gang Floor Box: Fully adjustable watertight cast iron gang floor boxes where shown on Drawings. Provide with removable partition and provide conduit openings in boxes as required. Install power circuits in separate raceway from data, telephone or other signal.
- C. Manufacturers:
 - 1. Appleton
 - 2. Carlon
 - 3. Crouse-Hinds
 - 4. Hubbell
 - 5. Thomas & Betts / Steel City
 - 6. Walker

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION - RACEWAY

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- F. Arrange raceway supports to prevent misalignment during wiring installation.
- G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- J. Do not attach raceway to ceiling support wires or other piping systems.
- K. Construct wireway supports from steel channel specified in Section 26 25 29.
- L. Route exposed raceway parallel and perpendicular to walls.

- M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.
- O. Maintain clearance between raceway and piping for maintenance purposes.
- P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.
- Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.
- U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.
- V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- AA. Close ends and unused openings in wireway.
- BB. Provide tracer wire on all underground raceway outside building slab on grade.

3.4 RACEWAY TYPES

- A. The following raceway types are to be used in the following locations:
 - 1. Under Slab on Grade: Schedule 40 PVC.
 - 2. Outdoor Locations, Above Grade: Rigid galvanized steel.
 - 3. Wet and Damp Locations: Rigid galvanized steel.
 - 4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
 - 5. Underground:
 - a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs,

- parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.
- b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6" above raceway.
- 6. Transformers and Motors: 24 inch flexible metal conduit to equipment.
- 7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.
- 8. Cooling Towers: PVC coated rigid galvanized steel within 50 feet of tower.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.
- B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Do not fasten boxes to ceiling support wires or other piping systems.
- G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18" of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.
- H. All outdoor boxes shall be UL listed for wet location service.
- I. Provide rigid support to structure for all junction boxes.
- J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.
- K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.
- L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.
- M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.6 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.7 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.8 INSTALLATION - FLOOR BOXES

- A. Use cast floor boxes for installation in slab on grade.
- B. Set floor boxes level.
- C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.9 ADJUSTING

- A. Adjust floor box flush with finish material.

3.10 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Underground Warning Tape.
 - 3. Lockout Devices.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and standards: Comply with the following:
 - 1. National Electrical Code, NFPA No. 70.
 - 2. NEMA standards applicable to the product provided.
 - 3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Panduit Corp.
 - 2. American Labelmark Co.
 - 3. Markal Corp.
 - 4. Calpico, Inc.
 - 5. Ideal Industries, Inc.

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.
- C. Letter Size:
 - 1. 1/4 inch high letters for identifying individual equipment and loads.

- D. Minimum nameplate thickness: 1/8 inch.

2.3 UNDERGROUND WARNING TAPE

- A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Install nameplates for the following:
 - a. Switchboards
 - b. Panelboards
 - c. Transformers
 - d. Service Disconnects
 - 1) Enclosed Switches
 - e. Motor Control Centers
 - f. Stand-alone Motor Controllers
 - g. Generators
 - h. Contactors
- C. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
 2. Install line marker for underground wiring, both direct buried and in raceway.
- D. Printed Panelboard Directory:
1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
 2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
 3. Copy in Owner's Manual.

3.3 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

3.4 ARC FLASH WARNING LABEL

- A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard boundary distance and the incident energy to which personnel could be exposed during work on or near energized electrical equipment.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- D. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- E. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- F. SCCR: Short-circuit current rating.
- G. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- H. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data: Submit information regarding computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals **[shall]** **[may]** be in digital form:

1. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
2. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
3. Exported data from computer-based, one-line diagram detailing the system data used for the arc-flash calculations, provided in .csv or Microsoft Excel format.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 1. For Power Systems Analysis Software Developer.
 2. For Power System Analysis Specialist.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

- A. Arc-Flash Hazard Analysis:
 1. Provide final arc-flash hazard analysis report in hard copy and digital format.
 2. Provide digital file containing electrical system model in a format consistent with power system analysis software used to perform study.
 3. Provide library files for power system analysis software used to perform study.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 1. Computer program shall be designed to perform arc-flash analysis.
- E. Power Systems Analysis Specialist Qualifications: Professional or qualified engineer in charge of performing the arc-flash study, analyzing the arc-flash results, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional or qualified engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide software developed and sold by EasyPower software with ANSI ShortCircuit, ArcFlash, PowerProtector, Scenario Manager, SmartDuty and SmartBreaker or comparable product by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics, Corporation.
 - 3. **<Insert manufacturer's name>**.
- B. Software must provide results consistent with the requirements of the latest versions of IEEE 1584 and NFPA 70E.
- C. Software capable of creation and storage of unlimited number of operating scenarios. All scenarios stored in the same project model file. System changes made to the base case automatically propagated to each operating scenario.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, indicating the following:
 - 1. Protective device designations, locations, and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 - 4. Motor and generator ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 - 6. Utility sources.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Equipment Duty Report: As specified in Section 260573.13 "Short-Circuit Studies."
- F. Data on all protective devices; manufacturers, types, sizes and adjustable settings that were used for the arc-flash calculations.
- G. List of protective devices found to be inoperable or with signs of impending failure. These devices must be clearly listed and excluded from use in determination of the arc time.
- H. Equipment Duty Study: Report to verify that all protective devices have adequate short-circuit ratings to interrupt the calculated maximum short-circuit current.
- I. Arc-Flash Study Calculations and Output Reports:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.

5. Restricted approach boundary.
 6. Limited approach boundary.
 7. Working distance.
 8. Incident energy.
- J. Arc-Flash Study input data, scenario descriptions, and arc-flash calculations including a definition of terms and guide for interpretation of the arc-flash hazard report. Study input data must be provided in electronic form as .csv or Excel files.

2.3 ARC-FLASH WARNING LABELS

- A. Provide a weatherproof, self-adhesive equipment label for each location requiring arc-flash hazard identification.
1. Minimum Size: **6 inches (150 mm)** wide by **4 inches (100 mm)** high.
 2. Sample label submitted for review prior to printing of actual labels.
- B. Content: Orange header with the wording, "WARNING, ARC-FLASH HAZARD, Arc-Flash and Shock Risk Assessment, Appropriate PPE Required." and the following information taken directly from the arc-flash hazard analysis:
1. Equipment ID.
 2. Nominal voltage.
 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 4. Available incident energy.
 5. Working distance.
 6. Engineering report number, revision number, and issue date.
- C. Completely machine printed, no field-applied markings.
- D. Compliance: NFPA 70E.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project electrical equipment submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study. The report shall clearly state any assumptions that were necessary to complete the analysis.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with the latest versions of NFPA 70E for the arc-flash hazard analysis study.
- B. Study all operating scenarios to determine the maximum incident energy at each location.

- C. Submit proposed arc-flash analysis scenarios for review prior to performing arc-flash calculations. Arc-flash hazard analysis report shall indicate which scenario created the maximum arc-flash energy for each location. All arc-flash calculations must be performed in accordance with the procedures and recommendations contained in the latest version of IEEE 1584. Calculate the arc-flash hazard boundary and incident energy at all locations in electrical distribution system where personnel could service or examine equipment while energized.
- D. Include all three-phase medium- and low-voltage equipment locations.
- E. Calculate the limited and restricted approach boundaries for each location.
- F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources or fault current that changes with time during the fault. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented based on the recommendations in IEEE 399 and ANSI C37 where applicable.
- G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
 - 1. When the circuit breaker is in a separate enclosure.
 - 2. When the line terminals of the circuit breaker are separate from the work location.
- H. Base arc-flash calculations on the time-current curve or operating time of the fastest upstream device using the predicted arcing current through that device. For medium-voltage circuit breakers, the breaker interrupting time must be automatically added to the relay operating time. Based on the recommendations in IEEE 1584 and sound engineering judgment, a maximum arc time of two seconds can be applied for situations where the protective device operating time is found to exceed two seconds.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
 - 1. Verify completeness of data supplied on one-line diagram on Drawings. Call any discrepancies or missing information to Owner's attention.
 - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer. Data shall include, but are not limited to, the following:
 - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance or available short-circuit current at each service.
3. Short-circuit current at each system bus (three phase and line to ground).
4. Voltage level at each bus.
5. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio if available, tap settings, and phase shift.
6. For reactors, provide manufacturer and model designation, voltage rating and impedance.
7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, short-circuit rating, continuous current rating, and settings for all adjustable settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
11. Motor horsepower.
12. Low-voltage conductor sizes, lengths, number, conductor material, and conduit material.
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material.

3.4 LABELING

- A. Apply **[one]arc-flash label on the front cover [of each section of the equipment] [and on side or rear covers with accessible live parts and hinged doors or removable plates]** for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 1. Motor-control center.
 2. Low-voltage switchboard.
 3. Switchgear.
 4. Medium-voltage switch.
 5. Low voltage transformers.
 6. Panelboard.
 7. Safety switch.
 8. Fused disconnect switch.
 9. Enclosed circuit breaker.
 10. Adjustable frequency drive.
 11. Control panel.
 12. **<Insert any other equipment that could be serviced or examined while energized>.**

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the interpretation of arc-flash warning labels.

END OF SECTION 26 05 73.19

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the owner will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the OWNER's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the OWNER and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to

forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for

review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

- A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the OWNER Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 26 09 14 - ELECTRICAL CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete and operational electrical control systems as outlined within this Section.
- B. Refrigerant detection and alarm system is provided by Division 23 Mechanical.
- C. Elevator Shutdown System(s): All heat detectors, supervisory addressable modules, and supervised fire alarm wiring shall be furnished and installed as part of building fire alarm system. Refer to section 28 31 00 for additional requirements of fire alarm system.

1.3 SUBMITTALS

- A. Provide submittals according to Section 26 05 00. Coordinate with section 28 31 00 Fire Alarm System Submittal for Items to be furnished and installed as part of the Fire Alarm System.
- B. Product Data:
 - 1. Component manufacturer's literature explaining all components of each system.
- C. Shop Drawings:
 - 1. Complete point to point interface and control wiring schematics.
 - 2. Show size and location of all fused elevator shutdown switches and panels. Identify all fuse types, quantity and ampacity.
- D. Closeout Submittal: Provide manuals as described in Section 26 05 00.

1.4 OWNER'S INSTRUCTION

- A. Provide a one hour period of instruction for each system to the Owner's designated personnel upon completion of system installation. Instruction shall include a functional training session on operation and system test procedures.
- B. Elevator Power Shutdown System: Schedule instruction after building fire alarm system becomes operational. Demonstrate that heat detector(s) is connected to the building fire alarm system and that fire alarm system output connects into shunt trip circuit of the elevator power shutdown switch(s).

1.5 EXTRA MATERIALS

- A. General: Provide extra material's for Owner's use. All parts shall be identical to installed components.
- B. Fuses:

1. Full Set: A full set is (three phase) of each different ampacity fuse in an elevator shutdown panel and in each elevator shutdown switch.
2. Provide two full sets of spare fuses for each elevator shutdown panel and switch. Fuses blown and replaced during construction and commissioning do not count as spares.
3. Provide a metal cabinet in each elevator machine room for the spare fuses. Cabinet shall be furnished by the fuse manufacturer or approved equal.

PART 2 - PRODUCTS

2.1 ELEVATOR POWER SUPPLY AUTOMATIC DISCONNECT SYSTEM:

- A. General: Provide an elevator power automatic disconnect system in each elevator equipment room as required by ASME A17.1 Elevator Safety Code Rule 102.2 (c). Heat detectors and other parts of automatic disconnect means shall be separate from, and independent of, the building fire alarm system. Disconnecting means shall not be self-resetting.
- B. State Regulation: Make arrangements for all inspections required by State of Texas. Correct any deficiencies in elevator electrical power supply automatic disconnect system that may be noted by State elevator inspector. Repeat until successful completion of all State of Texas Inspection Reports and Certificates of Compliance as required for ELEVATORS, ESCALATORS AND RELATED EQUIPMENT by the Texas Department of Licensing and Regulation.
- C. NFPA: Comply with National Fire Protection Association Standard 72-1999, National Fire Alarm Code, Sect. 3-9.4 (1996 NFPA 72 section 3-8.15).
- D. Disconnecting Means:
 1. Single-Car Machine Room: Provide Bussmann Power Module Switch Cat. No. PS in NEMA 3R enclosure. Switch rating amps shall be next size larger than fuses. All fuses shall be Class J current-limiting fuses. Provide shunt trip, 120 Volt control power transformer, Bussmann Option R2 fire alarm interface relay and key test switch for elevator feeder. Entire assembly shall be UL-listed and have 200,000 RMS symmetrical ampere interrupting rating.
 2. Class J Fuse Sizing: 175% Full Load Amps per elevator motor.
 3. Enclosure: NEMA 3R.
 4. Label: Label shunt-trip fused switch "Elevator Automatic Disconnect".
 5. Install wiring to remote heat detectors. Bussmann Option A: Comply with NEC 620-91 (c). For each hydraulic elevator that has automatic recall, provide one Bussmann Option A with fused switch for that elevator shutdown. Option A is a normally-closed mechanical interlock. It prevents inadvertent recall of hydraulic elevator. Automatic recall for hydraulic elevator is typically a Division 14 item for battery pack and electric solenoid on the hydraulic valve at the elevator controller. Automatic recall is typically provided when the hydraulic elevator is not on standby generator power.
- E. Heat Detector:
 1. Install an approved heat detector with replaceable heat element within two feet of each sprinkler head in each elevator equipment room, each elevator pit, and in each elevator hoistway. Connect all heat detectors to contactor shunt trip(s) described above. Heat detector shall cause shunt trip to open the contactor associated with each elevator fused switch.
 2. Heat detector shall have a lower temperature rating than the sprinkler head. Ex. 135°F-fixed temperature detector versus 165°F sprinkler.

3. Heat detector shall also have higher sensitivity than sprinkler. Detector higher sensitivity is often characterized by lower response time index (RTI). Listed spacing of heat detector shall be 40 feet or greater (NFPA 72, sect. Appendix 3-8.15.1).
4. Heat detector shall be combination rate-of-rise and fixed-temperature design as recommended in ASME Handbook to ANSI/ASME A17.1 Safety Code for Elevators and Escalators, explanation for Rule 102.2 (c)(3).
5. Install a heat detector at each sprinkler head in all following locations that have sprinklers:
 - a. Elevator machine rooms;
 - b. Elevator hoistway;
 - c. Elevator pit.
6. Heat detector shall be Notifier Model No. HD-621 or approved equal. Detector shall have Normally Open, dual output contacts. Both contacts shall be rated at least 3A @ 6-125 Vac and 1A @ 6-28 Vdc.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All components shall be properly mounted and wired.

3.2 INTERFACE WITH INVOLVED EQUIPMENT:

- A. Each system shall have all necessary control circuitry, relays, and contacts to provide functions as specified, and shall be capable, if necessary of interfacing to voltages 12-120 AC/DC, N/O or N/C contacts, wet or dry contacts, and momentary or maintained signal required. Verify type of interface control required with manufacturer of associated equipment. Provide necessary control power system for any wet contacts that are required, including control transformers, rectifiers, wiring, circuit breakers, etc.

3.3 CONTROL POWER SUPPLY:

- A. Elevators: Provide 120 volt control power as required from the same 208/120 volt circuit breaker panelboard serving the various 120V branch circuits in the elevator machine room.

3.4 ELEVATOR DISCONNECT:

- A. National Electrical Code:

NEC 620-51 (b): Provide a disconnecting means for main power supply conductors to each elevator car. The elevator disconnecting means shall be part of the automatic shutdown system to open the power supply prior to application of sprinkler water.

NEC 620-51: The disconnecting means for the main power supply conductors to each elevator car shall not disconnect the branch circuits required by NEC 620-22, 620-23 and 620-24.

3.5 TESTING:

- A. Test each system in the presence of the Owner, Architect, and Engineer to verify proper operation of elevator power supply automatic disconnect systems.

- B. State Elevator Inspector: Include State Elevator Inspector in test witnessing. At the sole option of the State Elevator Inspector, provide separate testing as that person may require. Provide all testing of disconnect systems as required by State Elevator Inspector to allow all Inspection Reports and Certificates of Compliance to be completed.

END OF SECTION 26 09 14

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes enclosed contactors for lighting and general purposes. Provide complete systems using contactors, relays, photocells, time clocks, or digital time switches, where required, all properly mounted in enclosures.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, size, voltage ratings and current ratings.
- B. Short circuit current rating (SCCR) of equipment.
- C. U.L. Label.
- D. Electrical characteristics of equipment.
- E. Enclosure metal gauge and finish.

1.4 CLOSEOUT SUBMITTALS

- A. Provide manuals as described in Section 26 05 00.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

- A. General: Provide contactors and relays with ratings as indicated or as required to operate the installed load at the applied voltage using the applied contact voltage. Contactor shall be rated for making and breaking motor or other inductive loads.
- B. Manufacturers:
 - 1. ASCO
 - 2. Square D
 - 3. GE
- C. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.
- D. Lighting Contactors:
 - 1. Mechanically held, electrically operated.
 - 2. ASCO 918 or approved equal.

3. Provide ASCO Accessory 47 for two-wire control of contactor. Provide time switch and photocell to control contactor.
 4. Some lighting contactors may be designated for control by Division 23 Building Automation System (BAS). Provide contactor and ASCO solid-state Accessory 47 for two-wire control of contactor. Division 23 shall provide all BAS control wiring. BAS provides all time-of-day ON/OFF scheduling.
 5. Three-phase Contactors: When lighting contactors are indicated to control an entire panel or sub-panel, provide ASCO 920 or approved equal. Include two-wire control relay ASCO Accessory 47.
 6. Parking Lot, Exterior Lighting and Sport Lighting Contactors: Provide 3-phase, 3-pole ASCO 920 contactors as indicated on Drawings. Include two-wire control relay ASCO Accessory 47. Also provide solid state control module and housing with Hand-off-Auto selector switch. All contactors that control any branch circuit that serves any lighting fixtures or entire panels that feed outdoor lighting shall be provided with the HOA control feature.
- E. SCCR: Contactor shall have short circuit current rating established by actual testing with specific overcurrent protection device. SCCR shall be UL-listed.

2.2 PHOTO-ELECTRIC CONTROLS:

- A. Description:
1. General: Photo-electric control shall switch load ON at dusk and OFF at dawn.
 2. Housing: Photocell shall be enclosed in a weatherproof, corrosion resistant housing. The housing shall have a 1/2 inch I.P.S. nipple with a locking washer.
 3. Element: Light sensing element shall be Cadmium-Sulfide cell hermetically sealed against moisture. Minimum time delay before change-of-state shall be 15 seconds. If the photo-electric control fails, the load shall switch ON (fail-safe ON).
 4. Adjustment: The housing shall have an adjustable slide shield to vary the ambient light reaching the CdS cell. The slide shield shall not override the control; that is, the ON/OFF function shall occur even when the shield is at either extreme of the adjustment range. Adjustment shall be made by hand without tools.
 5. Temperature: The photocell shall be suitable for operation in an ambient temperature range of -30 degrees Fahrenheit to + 140 degrees Fahrenheit.
 6. Voltage: The photocell shall be suitable for use at voltage equal to the load voltage (120, 208, 277).
 7. Capacity: Photocell shall be SPST rated for a minimum of 1800 Volt-Amps resistive or inductive load.
 8. Leads: Photocell shall have minimum six (6) inch wire leads with wet location insulation. Leads shall be color coded Red/Load, Black/Line and White/Neutral.
 9. Listing: Photocell shall be listed by Underwriters Laboratories.
- B. Manufacturer: Intermatic, Paragon, Precision, Tork.

2.3 TIME CLOCKS:

- A. Manufacturer:
1. Grasslin
 2. Intermatic
 3. Paragon
 4. Precision
 5. Tork

- B. General: Provide time clocks similar to Intermatic Series T 1900 or Tork B8000 Series. Provide wiring to photocells, contactors, relays or other control points as required.
- C. Contacts: Rated for 20 amps minimum at 277 volts. Provide 1, 2, 3 or 4 pole, single or double throw, maintained or momentary contact, as required based on the time clock function and the number of branch circuits controlled. Contacts shall be horse power rated when motors are switched.
- D. Dial: Provide 24-hour dial with 15 minute intervals minimum. Dial shall permit at least 48 ON/OFF cycles per day via 96 adjustable tabs. Dial shall include a skip-a-day wheel and two day-omitting pins. Provide extra trippers and day-omitting pins if required.
- E. Special Dials: Provide special dial where indicated on drawings or in these specifications. Provide astronomic dial for time clock controlling outdoor lighting.
- F. Timing Motor: Provide heavy duty synchronous timing motor, self-starting and permanently lubricated. Motor shall be permanent magnet type for high torque and operate through and ambient temperature range of - 30 degrees Fahrenheit to + 130 degrees Fahrenheit. Motor cover shall have a viewing window to check for rotation of gears. Motor voltage shall be 120, 208, 240 or 277 volts as required.
- G. Reserve Power: Provide a spring driven reserve power drive to operate time clock for at least ten (10) hours after a power failure.
- H. Manual Bypass:
 - 1. Time clock shall include a manual ON/OFF bypass switch capable of overriding time schedule without disturbing trippers or timing sequence.
 - 2. Time clock shall be installed with a pilot-light SPST toggle switch mounted in a separate, adjacent single-gang box. Switch shall be labelled "Bypass" and shall function to turn ON circuit(s) controlled by the time clock. Switch shall be flush or surface mounted to match time clock housing.
- I. Terminals: Time clock shall have a terminal block with screws for line, load, and grounding connections with up to AWG #8 wire. Provide a removable dead-front terminal cover within the time clock case. Timing motor shall have separate, unswitched terminals.
- J. Enclosure: Provide a NEMA 1 enclosure with hasp suitable for padlock and side-hinge door for all clocks located indoors. Enclosure shall have 1/2 inch and 3/4 inch knockouts in bottom and sides. Provide NEMA 4X for those located outdoors and in wet areas.
- K. Nametag: Provide a nametag for each time clock stating load controlled; see Section 26 05 53, Electrical Identification.
- L. Listing: All time clocks shall be listed by Underwriters Laboratories and C.S.A.
- M. Manuals: Provide three sets, each consisting of operating instructions and one-line diagrams.

2.4 DIGITAL TIME SWITCHES:

- A. Recessed in wall: Wattstopper TS-400 or approved equal.
 - 1. The digital time switch shall be programmable to turn lights off after a preset time.

2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.
3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch's longevity.
4. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC.
7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.
12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

2.5 OCCUPANCY SENSORS:

- A. Ceiling Sensors: Require power packs
 1. W-2000- Low voltage ultrasonic ceiling mounted with 2000 square foot coverage. Typical for large restroom.

- DT-300- Low Voltage dual technology ceiling mounted with isolated contact. Typical for classrooms.
 - 2. WT-2250/2255- Typical corridor sensor- Low voltage ultrasonic ceiling mounted with 10' by 90' coverage pattern
- B. Wall Switch Sensors:
- 1. PW-100 Line voltage PIR wall switch sensor for 1 circuit- Typical for small office or single person restroom.
PW-100-24 Low Voltage PIR wall switch sensor. Requires power pack
PW-200- Line voltage PIR wall switch sensor for 2 circuits,
UW-100- Line Voltage ultrasonic wall switch sensor for 1 circuit.
DW-100- Line voltage dual technology wall switch sensor for 1 circuit. Typical for large office or conference room.
DW-100-24- Low voltage dual technology wall switch sensor. Requires Power Pack
DW-200- Line voltage dual technology wall switch sensor for 2 circuits
 - 2. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
 - 3. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
 - 4. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life protects from the effects of inrush current, and increases sensor's longevity.
 - 5. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
 - 6. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
 - 7. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
- C. Power and Auxiliary Packs:
- 1. BZ-50- Standard power pack for use with low voltage sensors. 225ma
 - 2. BZ-150- Power pack for use with low voltage sensors when using a manual on function. 225ma
 - 3. S120/277- Slave relay pack. For controlling more than 1 circuit from a low voltage sensor. Standard BZ-50 can also be used.
- D. High Ceiling Applications
- 1. HB-350B*LENS Low Voltage PIR sensor
 - 2. L1 Lens- 20' x 60' coverage pattern when mounted at 40'
 - 3. L3 Lens- 40' diameter coverage pattern when mounted at 40'
 - 4. L4 Lens- 60' diameter coverage pattern when mounted at 60'
- E. Passive infrared sensors:
- 1. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.
 - 2. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
 - 3. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
 - 4. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

- F. Dual technology sensors:
 - 1. Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
 - 2. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
- G. Ultrasonic sensors:
 - 1. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
 - 2. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
- H. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
- I. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- J. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.
- K. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- L. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- M. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- N. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
- O. All sensors shall have UL rated, 94V-0 plastic enclosures.
- P. All occupancy sensors shall be set to maximum 30 minute time delay.
- Q. Provide minimum 5% spare sensors for owner stock of each type of occupancy sensor.

2.6 DAYLIGHT HARVESTING – Wattstopper LightSaver® LS-102 Daylighting Controller

- A. The light level controller shall be capable of detecting changes in lighting levels.
- B. The light level controller shall utilize an internal photocell that measures light in a 100 degree angle cutting the unwanted light from bright sources outside of this cone.
- C. The light level controller shall be capable of controlling any type of lighting through use of power packs. Light level controller shall operate from a 24 volts DC power supply; current draw is 22 milliamps.
- D. The LS-102 light level controller shall be capable of turning lighting on and off for a single zone and has a light sensors over 1 to 1400fc.
- E. The light level controller shall have an adjustable deadband feature with 25%, 50%, 75% or 100% in relation to the setpoints. This prevents lighting from cycling when lighting goes on and off and from minor changes due to cloud cover.
- F. The light level controller shall have an adjustable time delay range of 3, 10, 15 or 30 minutes. This will prevent cycling on partly cloudy days and is necessary with HID lighting.
- G. The LS-102 shall provide a connection for an optional low voltage, normally open momentary contact watt switch override.
- H. The LS-102 provides a “hold on while occupied” feature that prohibits high levels from turning OFF the controlled lights as long as the space remains occupied.
- J. The LS-101 has an ON Setpoint range from 1-850fc and when the daylight drops below that setpoint for 20 seconds the electric lights will be turned ON.
- K. The LS-102 has a microprocessor that allows the photosensor to respond with precision to deliver the desired intensity of electric lighting for the space.
- L. The light level controller has a LED status indicator making it easy to identify if the device has been forced on or off by an override switch or if the device is in test mode.
- M. The LS-102 has a threaded nipple that mounts on a ceiling tile and for more challenging applications such as a side wall or hard rock ceiling the nipple pops off and the LS-101 can be screwed down.
- N. Light level controller shall have standard 5 year warranty.

2.7 SPORTS LIGHTING CONTROL STATION

- A. General: Provide pushbuttons for manual override of programmable relays designated to control the power contactors for the outdoor sports lighting at each field. Arrange pushbuttons into a single enclosure for each field.

- B. Enclosure: Enclosure shall be NEMA 4X stainless steel or polycarbonate with gasketing for outdoor wet locations.
- C. Pushbutton: Similar to Square D Class 9001-Type B, Type BW245, NEMA 4, momentary contact, RED/ON and GREEN/OFF pushbuttons with collar guard.
- D. Wiring: From each pushbutton in the Sports Lighting Control Station, provide low voltage wiring to the programmable relay cabinet.
- E. Control: BAS schedules all power contactors for outdoor sports lighting via the programmable relay system. Each sports field shall have a programmable relay assigned to the contactors for the sports lighting of that field. BAS will program automatic schedules for the sports lighting as required. User shall be able to override automatic schedule from BAS with manual ON/OFF signals from the pushbutton Lighting Control Stations. Pushbutton signals relay cabinet, similar to a classroom light switch, and relay causes the lighting contactors to change state (OFF to ON, ON to OFF).
- F. Engraving: Provide engraved lamacore plate above each pushbutton describing the lighting it will control. Example: TENNIS COURTS; FOOTBALL-EAST POLES, FOOTBALL-WEST POLES, BASEBALL, SOFTBALL.
- G. Relays: For each pushbutton control, provide a relay in the local relay cabinet nearest the sports lighting contactors. Wire relay to the control circuits of the associated sports lighting contactors. Program BAS for both automatic scheduling of the sports lighting and to accept manual override from pushbutton Sports Lighting Control Stations.

PART 3 - EXECUTION

3.1 PHOTO-ELECTRIC CONTROL MOUNTING:

- A. Provide photo-electric control on roof of building. When more than one building is constructed on site, install photo control on each roof. Aim true North and locate in places where ambient night lighting will not cause interference. Wire down to respective contactors in each building.

3.2 TIME CLOCK PROGRAMMING:

- A. Install time clock and photocell for ON by photocell at dusk, OFF by time clock at midnight, then ON by time clock at 5:00 a.m. and OFF by photocell at dawn. Program time clock ON/OFF times to other time(s) when indicated on Drawings.

3.3 INSTALLATION

- A. Install enclosed contactors (as indicated on Drawings), in accordance with NECA "Standard of Installation".
- B. Install engraved nameplates. Refer to Section 26 05 53 for requirements.
- C. Install contactor and relays in Electrical / Mechanical Rooms unless otherwise noted.

END OF SECTION 26 09 23

SECTION 26 09 43 – NETWORKED DIGITAL LIGHTING CONTROLS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Digital Occupancy and Daylighting Sensor Control
 - 2. Emergency Lighting Control
- B. Related Section
 - 1. Section [260926 – Lighting Control Panel Boards:] Lighting panels (switching) controlled by Digital Network Lighting Control System.
 - 2. Section [260936 – Modular Dimming Controls:] Digital Lighting Management
 - 3. Section [262726 - Wiring Devices:] Receptacles
 - 4. Section [265113 – Interior Lighting Fixtures, Lamps, and Ballasts:] Fluorescent electronic dimming ballasts.
 - 5. Section [25000 – Integrated Automation] Building integrator shall provide integration of the lighting control system with Building Automation Systems.
 - 6. Drawings and general provision of the Contact, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section
 - 7. Electrical Sections, including wiring devices, apply to the work of this Section.
- C. Control Intent – Control Intent includes, but is not limited to:
 - 1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
 - 2. Initial sensor and switching zones
 - 3. Initial time switch settings
 - 4. Task lighting and receptacle controls
 - 5. Emergency Lighting control

1.3 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- B. Underwriter Laboratories of Canada (ULC)
- C. International Electrotechnical Commission
- D. International Organization for Standardization (ISO)
- E. National Electrical Manufacturers Association (NEMA)
- F. WD1 (R2005) - General Color Requirements for Wiring Devices.

- G. Underwriters Laboratories, Inc. (UL)
 - 1. 916 – Energy Management Equipment.
 - 2. 924 – Emergency Lighting

1.4 SYSTEM DESCRIPTION & OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
 - 1. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relays controllers with **integral current thyristor**, 0-10 volt control for ballasts.
 - 2. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 - 3. Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
 - 4. Digital Photosensors – Single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
 - 5. Configuration Tools – Handheld remote for room configuration provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send and receive of room variables and store of occupancy sensor settings. Computer software also customizes room settings.
 - 6. Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.
 - 7. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
 - 8. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS).
 - 9. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
 - 10. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

1.5 SUBMITTALS

- A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- B. Shop Drawings:
 - 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
 - 2. Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.
- C. Product Data: Catalog sheets, specifications and installation instructions.
- D. Include data for each device which:
 - 1. Indicates where sensor is proposed to be installed.
 - 2. Prove that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum [10] years' experience in manufacture of lighting controls. Provide list of (5) projects that have been complete for more than (1) year within 100 miles of new project location.

1.7 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 - 1. Ambient temperature: 0° to 40° C (32° to 104° F).
 - 2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

- A. Provide a five year complete manufacturer's warranty on all products to be free of manufacturers' defects.

1.9 MAINTENANCE

- A. Spare Parts:
 - 1. Provide 5% spares of each product listed below to be used for maintenance. Electrical Contractor shall deliver items to Owner within 30 days of substantial completion.
 - a. Room Controllers
 - b. Occupancy Sensors
 - c. Emergency Bypass controllers
 - d. Low voltage switches
 - e. Daylighting harvesting photocells

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - 1. WattStopper (basis of design)
 - 2. Acuity

2.2 SINGLE / DUAL RELAY WALL SWITCH OCCUPANCY SENSORS

- A. Type PW: Manual-ON, Automatic-OFF passive infrared (PIR) wall switch occupancy sensor. Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper PW-100, PW-200, PW-103, PW-203, PW-301, PW-302, WS-301.
- B. Type UW: Manual-ON, Automatic-OFF ultrasonic wall switch occupancy sensor with. Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper UW-100, UW-200.

- C. Type DW: Manual-ON, Automatic-OFF dual technology (passive infrared and ultrasonic) wall switch occupancy sensor. Furnish the Company's model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled; WattStopper DW-100, DW-200, DW-103, DW-203, DW-311, DSW-100, DSW-200, DW-103, DW-203, DSW-301, DSW-302.

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters. Passive infrared only sensors shall not be used for classroom applications.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
1. Digital calibration and pushbutton programming for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 2. One or two RJ-45 port(s) for connection to DLM local network.
 3. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 4. Device Status LEDs including:
 - a. PIR Detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
 5. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 6. Manual override of controlled loads.
- C. Units shall not have any dip switches or potentiometers for field settings.
- D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- E. All devices shall be hard wired. No wireless devices shall be permitted.
- F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.4 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in multiple button configuration; available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:
1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.

2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 3. Red configuration LED on each switch that blinks to indicate data transmission.
 4. Blue Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
- B. Two RJ-45 ports for connection to DLM local network.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- D. The following switch attributes may be changed or selected using a wireless configuration tool:
1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.
- E. WattStopper product numbers: LMSW-210, LMSW-211, LMSW-220, LMSW-222, LMSW-241, LMSW-250

2.5 ROOM CONTROLLERS

- A. Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 3. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
 4. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
 5. Plenum rated UL 2043
 6. Manual override and LED indication for each load
 7. Dual voltage (120/277 VAC, 60 Hz)
 8. Zero cross circuitry for each load.

- B. On/Off/Dimming enhanced Room Controllers shall include:
 - 1. Real time current monitoring
 - 2. One, two or three relay configuration
 - 3. Efficient 250 mA switching power supply
 - 4. Four RJ-45 DLM local network ports.
 - 5. One 0-10 volt analog output per relay for control of compatible ballasts and LED drivers.
 - 2. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
 - 6. WattStopper product numbers: LMRC-111, LMRC-112, LMRC-211, LPMC-212, LPMC-213

2.6 DIGITAL PHOTOSENSORS

- A. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.
- B. Digital photosensors include the following features:
 - 1. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
 - 2. Sensor light level range shall be from 1-10,000 footcandles (fc).
 - 3. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
 - 4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling after they turn off.
 - 5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
 - 6. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
 - 7. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
 - 8. Red configuration LED that blinks to indicate data transmission.
 - 9. Blue status LED indicates test mode, override mode and load binding.
 - 10. Recessed switch to turn controlled load(s) ON and OFF.
 - 11. One RJ-45 port for connection to DLM local network.
 - 12. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.

- C. Closed loop digital photosensors include the following additional features:
 - 1. An internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from bright sources outside of this cone.
 - 2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
 - 3. Automatically establishes setpoints following self-calibration.
 - 4. A sliding setpoint control algorithm for dimming daylight harvesting with a "Day Setpoint" and the "Night Setpoint" to prevent the lights from cycling.
 - 5. WattStopper Product Number: LMLS-400.
- D. Open loop digital photosensors include the following additional features:
 - 1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
 - 2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
 - 3. A proportional control algorithm for dimming daylight harvesting with a "Setpoint" to be maintained during operation.
 - 4. WattStopper Product Number: LMLS-500.

2.7 EMERGENCY LIGHTING

- A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
 - 1. 120/277 volts, 50/60 Hz., 20 amp ballast rating
 - 2. Push to test button
 - 3. Auxiliary contact for remote test or fire alarm system interface
- B. WattStopper Product Numbers: ELCU-100, ELCU-200.
- C. Generator Transfer Device – For corridors and other areas noted on plans that require a UL1008 device, provide Bodine GTD20A device.

2.8 ROOM NETWORK (DLM Local Network)

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. Features of the DLM local network include:
 - 1. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 - 2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
 - 3. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
 - 4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2.09 LIGHTING CONTROL PANELS

- A. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:
1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 – 8 relays, 1 – 24 relays and 6 four-pole contactors, or 1 – 48 relays and 6 four-pole contactors.
 2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
 3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
 - a. Removable, plug-in terminal blocks with screwless connections for all low voltage terminations.
 - b. Individual terminal block, override pushbutton, and LED status light for each relay.
 - c. Direct wired switch inputs associated with each relay and group channel shall support two-wire, momentary or maintained contact switches.
 - d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches, digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs, digital IO modules capable of receiving momentary or maintained contact closure inputs, digital photocell modules, and digital occupancy sensors.
 - e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
 - f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
 - g. Group, channel, and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any group of relays can be associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override pushbuttons and LED displays for channels 1-9 or a handheld IR programmer for channels 1-99.
 - h. Relay group status for each channel shall be provided through red LED indicators for groups 1-9 and via BACnet for groups 1-99. Solid red indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.
 - i. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
 - 1) Electrical:
 - (a) 30 amp ballast at 277V
 - (b) 20 amp ballast at 347V
 - (c) 20 amp tungsten at 120V
 - (d) 30 amp resistive at 347V
 - (e) 1.5 HP motor at 120V
 - (f) 14,000 amp short circuit current rating (SCCR) at 347V
 - (g) Relays shall be specifically UL listed for control of plug loads
 - 2) Mechanical:
 - (a) Individually replaceable, ½" KO mounting with removable Class 2 wire harness.

- (b) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
 - (c) Dual line and load terminals each support two #14 – #12 solid or stranded conductors.
 - (d) Tested to 300,000 mechanical on/off cycles.
 - 3) Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
- 4. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
- 5. Lighting control panels shall be WattStopper model LMCP8, LMCP24 or LMCP48 as shown on the plans.

2.10 BACnet® BASED DIGITAL COMMUNICATIONS

- A. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 master/slave token passing-based using the BACnet® protocol.
 - 1. The panel shall have provision for an individual BACnet device ID. The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
 - 2. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
 - 3. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
 - 4. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.
 - 5. The 99 channel groups associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.
 - 6. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:
 - a. Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.
 - b. Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control.
 - c. Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.
 - d. Analog value objects in the instance range of 1 – 64 (one per relay) shall assign relays to channel groups in the range of 1 – 99.
 - e. Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute gracetime

- period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.
- f. Analog value objects in the instance range of 201 – 299 (one per channel) shall assign an after hours time delay value to the channel in the range of 1 – 240 minutes.
 - g. Multi-state value objects in the instance range of 1 – 99 (one per channel) shall provide the state of the relays assigned to the channel. Valid states shall be ALL ON, MIXED, BLINK, and ALL OFF.
- 7. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.
 - 8. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum aa.
<http://www.bacnet.org/Addenda/Add-135-2010aa.pdf>
 - 9. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.
 - 10. Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.
 - 11. Lighting control accessory devices connected to the panel shall be represented via BACnet objects including but not limited to the following:
 - a. Digital occupancy sensor detection states shall be readable as BI objects ranging from BI1-96.
 - b. Digital occupancy sensor configuration parameters shall each be accessible as BACnet objects when applicable to a given product.
 - (1) Occupancy sensor time delay in minutes shall be writeable via AV101-196.
 - (2) Occupancy sensor passive infrared (PIR) sensitivity percentage shall be writeable via AV201-296.
 - (3) Occupancy sensor ultrasonic (US) sensitivity percentage shall be writeable via AV301-396.
 - c. Digital switch buttons shall be readable and writeable as BI objects ranging from BI101 – 9608.
 - d. Digital daylight sensors foot-candle readings shall be readable as follows:
 - (1) Analog 0-5V/0-10V sensors connected to a digital input module shall be represented as AI1-96.
 - (2) Digital closed loop sensors shall be represented as AI4001-4096.
 - (3) Digital open loop sensors shall be represented as AI5001-5096.
 - (4) Digital dual loop sensors shall be represented as follows:
 - (a) The upward facing open loop sensor shall be represented as AI6001-6096.
 - (b) The downward facing closed loop sensor shall be represented as AI6101-6196.
 - e. Digital daylight sensor configuration shall be exposed as BACnet objects as follows:
 - (1) Digital closed loop sensors shall be represented as follows:
 - (a) Daylight Sensor Day Setpoint (ftcd) AV4201-4296.
 - (b) Daylight Sensor Night Setpoint (ftcd) AV4301-4396.
 - (c) Daylight Sensor Off Setpoint Delay (minutes) AV4401-4496.
 - (d) Daylight Sensor On Setpoint (ftcd) AV4501-4596.
 - (e) Daylight Sensor Off Setpoint (ftcd) AV4601-4696.

2.11 USER INTERFACE

- A. Each lighting control panel system shall be supplied with at least (1) handheld IR remote programming interface consisting of a keypad and associated OLED display screen. The user interface shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following functions as a minimum:
1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
 2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.
 3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
 4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.
 5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
 6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
 7. An additional handheld IR remote may optionally be specified to be permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as seen fit by the end user's representative.

2.12 CONFIGURATIONS TOOLS

- A. A configuration tool facilitates optional customization of DLM local networks, and is used to set up open loop daylighting sensors. A wireless configuration tool features infrared communications, while PC software connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include:
1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
 3. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
 4. Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.
 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting.
 6. Adjust or fine-tune daylighting settings established during auto-commissioning, and input light level data to complete commissioning of open loop daylighting controls.
- C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.13 NETWORK BRIDGE

- A. The network bridge connects a DLM local network to a BACnet-compliant network for communication between rooms, panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication. Closed or proprietary network communication shall not be acceptable.
1. The network bridge may be incorporated directly into the room controller hardware (LMRC-3xx Room Controllers) or be provided as a separate module connected on the local network through an available RJ-45 port.
 2. Provide Plug n' Go operation to automatically discover all room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
 3. The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. Standard BACnet objects shall be provided as follows:
 - a. Read/write the normal or after hours schedule state for the room
 - b. Read the detection state of the occupancy sensor
 - c. Read/write the On/Off state of loads
 - d. Read/write the dimmed light level of loads
 - e. Read the button states of switches
 - f. Read total current in amps, and total power in watts through the room controller
 - g. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
 - h. Activate a preset scene for the room
 - i. Read/write daylight sensor fade time and day and night setpoints
 - j. Read the current light level, in footcandles, from interior and exterior photosensors and photocells
 - k. Set daylight sensor operating mode
 - l. Read/write wall switch lock status
 4. WattStopper product numbers: LMBC-300

2.14 SEGMENT MANAGER

- A. The Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall serve up a graphical user interface via a standard web browser. Each segment manager shall have support for one, two or three segment networks as required and allow for control of a maximum of 40 local networks (rooms) and/or lighting control panels per segment network.
- B. Operational features of the Segment Manager shall include the following:
1. Connection to PC or LAN via standard Ethernet TCP/IP.
 2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser.
 3. Log in security capable of restricting some users to view-only or other limited operations.
 4. Automatic discovery of all DLM devices on the segment network(s). Commissioning beyond activation of the discovery function shall not be required.

5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation.
7. Ability to set up schedules for rooms and panels. Schedules shall automatically set controlled zones or areas to either a normal hours or after hours mode of operation.
8. Ability to group rooms and loads for common control by schedules, switches or network commands.
9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.
10. Provide seamless integration with the BAS via BACnet IP. Provide export table with available parameters.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Contractor shall provide to the manufacturer all quantities for system including but not limited to relays, room controllers, relay panels, plug load controllers, switches, sensors and wire lengths and configurations for both network and device cable at least 1 week before bid.
- B. When using wire for connections other than the DLM local network (Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements
- C. All MSTP network and Cat 5e low voltage wiring must have "WattStopper" printed on the wire jacket. Any cable substitutions shall be removed and replaced at the contractor's expense.
- D. All MSTP network terminations shall utilize wire ferrules for terminations and MSTP network manufacturer's instructions. Any network deficiencies shall be repaired at the contractor's expense.
- E. Electrical contractor must provide a detailed as-built plan in CAD showing MSTP network cable routing and network bridge serial numbers to the manufacturer at least 3 weeks prior to factory commissioning. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- F. Electrical contractor shall be responsible for scheduling the following onsite coordination meetings through the duration of the project. Attendance shall be required for the GC, EC, representative from MEP firm, BAS Integrator and lighting control rep.
 1. Pre-Installation- After submittals have been approved and material has arrived onsite and before installation of any devices begins. Review lighting control layout plans, required as-built information and MSTP Terminations.
 2. Pre-Factory startup- Electrical contractor must have all lighting control devices installed, wired and tested at least 90 days prior to substantial completion deadline. At this coordination meeting the electrical contractor shall walk the site with attendees and go room by room to ensure they are ready for factory technician to start the system programming. Electrical contractor shall have his as built documentation of the system completed for this meeting.
 3. Move in- 30 days prior to owner move in all parties shall meet onsite to review completed system. At this time all installation and factory programming shall be completed.

3.2 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.

- B. The factory commissioning shall include the following services. Programming of all button stations, configuration of all occupancy sensors and photocells. Verification of a complete and working system including MSTP network status. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- C. The electrical contractor shall request factory commissioning by submitting a startup request form at least (4) weeks before startup is required.
- D. Electrical contractor must schedule lighting control factory start-up to begin at **least 60 days prior to substantial completion deadline.**
- E. Lighting control technician shall issue daily reports notifying of the project status, open issues, challenges, etc. at the end of each day he/ she is onsite commissioning the system. Reports shall be sent directly to EC, GC and Engineer.
- F. At the completion of the first visit of the lighting control technician, all parties shall meet onsite to walk the project and evaluate any open issues. At this meeting the schedule for owner training shall be determined.
- G. The electrical contractor shall provide at least (1) journeyman electrician, familiar with the installation of the system, dedicated to assisting the factory start-up technician for the entire duration of the commissioning process.
- H. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.
- I. Re-commissioning – After 90 days from occupancy the factory authorized representative and electrical contractor shall re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity
- J. Owner operation memo- Lighting control manufacturer shall prepare an operational memo for owner to distribute informing building occupants of the operation of their lighting control system. Memo shall explain the following but not limited to: auto on/ vs manual on, occupancy sensors, daylight harvesting, plug load control, after hours time delays.

END OF SECTION 26 09 43

SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

1.2 SUMMARY

- A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

1.3 QUALITY ASSURANCE

- A. New: Provide all new equipment.
- B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.
- D. NEC: Equipment and installation shall comply with the National Electrical Code.
- E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.
- F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.4 LABELING

- A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

1.5 FINISHES

- A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

1.6 SUBMITTALS

- A. Provide complete product data for each equipment type. Provide electric service studies when required.
- B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings.

Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

- C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

1.7 SHORT CIRCUIT CURRENT RATINGS

- A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

1.8 ELECTRIC SERVICE STUDIES

- A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.
- C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.
- D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.
- E. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.

1.9 OWNER'S INSTRUCTION

- A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. Review manufacturer's recommended

switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
1. Square D
 2. Siemens
 3. G.E.
 4. Cutler-Hammer

2.2 ENCLOSED SWITCHES

- A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.
- B. Switch Interior:
1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
 2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
 3. All current carrying parts shall be plated to resist corrosion.
 4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
 5. Switches shall have provisions for a field installable electrical interlock.
- C. Switch Mechanism:
1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
 2. The operating handle shall be an integral part of the box, not the cover.
 3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
 4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
 5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- D. Switch Enclosures:
1. Switch covers shall be attached with welded pin-type hinges.
 2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
 3. The enclosure shall have ON and OFF markings stamped into the cover.
 4. The operating handle shall be provided with a dual colored, red/black position indication,

5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.
 6. Tangential knockouts shall be provided to facilitate ease of conduit entry.
- E. Switch Ratings:
1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
 2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
 3. Non-Fusible: 10,000 rms symmetrical amps.
- F. Fuse Clips: NEMA FU 1, Class J fuses.

2.3 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES

- A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.
- C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.
- D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.
- E. Nameplate: Provide a nameplate showing load served.

2.4 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

- A. Square D - Class 2510 Type F.
1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
 2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

2.5 MAGNETIC MOTOR CONTROLLERS

- A. Square D - Class 8536 Type S.
1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
 2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.
 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 7. Wiring: Straight-through wiring with all terminals clearly marked.

8. Overload Relay: NEMA ICS.
 - a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
11. Provide red LED running pilot light and H-O-A switch.

2.6 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

- A. Square D - Class 8810 Type S.
 1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
 2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.
 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
 7. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 8. Wiring: Straight-through wiring with all terminals clearly marked.
 9. Overload Relay: NEMA ICS.
 - a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
 10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
 11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.
 12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.

13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

2.7 COMBINATION DISCONNECT / MOTOR STARTERS

- A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).
 1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
 2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.
 3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

2.8 FUSES (600 VOLTS AND BELOW)

- A. Manufacturers:
 1. Bussmann.
 2. Little Fuse
 3. Ferraz Shawmut
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Class J (Time Delay) Fuses
 1. Dimensions and Performance: NEMA FU 1.
 2. Voltage: Rating suitable for circuit phase-to-phase voltage.
 3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.
- E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

2.9 TWO-WINDING TRANSFORMERS

- A. Product Description: Provide transformers in accordance with the following standards, where applicable:
 1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
 2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
 3. NEMA ST 20, Dry Type Transformers for General Applications
 4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
 5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
 6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All

transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.

- B. Ratings as indicated on Drawing.
- C. Primary Voltage: 480 volts, 3 phase or as indicated on plans.
- D. Secondary Voltage: 208Y/120 volts, 3 phase or as indicated on plans.
- E. Insulation system and average winding temperature rise 150 degrees Celsius over 40 degrees Celsius ambient.
- F. Winding Taps:
 - 1. 2 at 2.5 percent above rated voltage.
 - 2. 4 at 2.5 percent below rated voltage.
- G. Sound Levels: NEMA ST 20. Noise levels shall not exceed NEMA and ANSI Standards.
- H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.
- I. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
- J. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for floor mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- K. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- L. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- M. Isolate core and coil from enclosure using vibration-absorbing mounts.
- N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.10 TRANSFORMERS FOR NONLINEAR LOADS

- A. Nonlinear load transformer shall be as specified for two winding transformers except as modified by this Section.
- B. Product Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, designed to supply nonlinear load, UL K-9 rated.
- C. Primary Voltage: 480 volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.
- E. Insulation and temperature rise: Class 220 insulation system with 115 degrees Celsius average winding temperature rise over 40 degrees Celsius ambient.

- F. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at 1.73 times the phase conductor ampacity.
- G. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- H. Isolate core and coil from enclosure using vibration-absorbing mounts.
- I. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.11 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Square D I-Line, Class 2110.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Continuous current rating shall be sufficient to protect wiring and equipment served.
 - 1. Panels 400A and smaller, 35,000 amperes rms symmetrical.
 - 2. Panels greater than 400A: 65,000 amperes rms symmetrical.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Main Circuit Breaker:
 - 1. When distribution panel has main circuit breaker, provide molded case circuit breaker with electronic trip unit. Current sensing to be true-rms.
 - 2. Main breaker shall have minimum interrupting rating of 65,000 amperes rms symmetrical at applied voltage.
 - 3. Electronic trip shall be Square D micrologic with adjustable long-time, short-time and instantaneous pick-up set points.
- G. Cabinet Front: Safety dead front type. Conform to NEMA 1; NEMA 3R if located outdoors. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

2.12 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;
- D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.

- E. Minimum Integrated Short Circuit Rating: 14,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.
- F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.
- H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
- I. Provide ground-fault circuit breaker for each heat trace branch circuit.
- J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.

2.13 MOTOR CONTROL CENTERS

- A. General:
 - 1. Provide totally enclosed, freestanding, motor control center with sections joined together to form one rigid unit. Motor control centers shall be similar to Square D Model 6 Class 8998.
 - 2. NEMA Class: I.
 - 3. NEMA Wiring Class: Type B.
 - 4. Standard: NEMA Standard ICS 2 Industrial Control and Systems.
 - 5. Underwriters Laboratories: UL 845 "Electric Motor Control Centers". Each vertical section shall be UL listed. Each motor control unit shall be UL listed.
- B. Installation: Freestanding on a four (4) inch concrete pad. Both the entire enclosure to the pad.
- C. Structure:
 - 1. Fabricated of code gage steel with steel doors formed into standardized units. Each vertical section shall have an independent isolated vertical wiring trough with full height hinged door. Back to back mounted devices in the same vertical bus module are unacceptable.
 - 2. Structures shall be totally enclosed, dead front, freestanding assemblies.
 - 3. Structure shall be NEMA type 1 gasketed general purpose.
 - 4. Motor control center structures shall have continuous removable base channels. The top plate(s) shall be removable to facilitate cutting of conduit entry openings.
 - 5. All steel parts shall be provided with a UL listed acrylic baked enamel or powder coat paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
 - 6. Structures shall contain a minimum 12 inch high horizontal wireway at the top of each section and a minimum six (6) inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of the motor control center to allow room for power and control cable to connect between units in different sections.
 - 7. A vertical wireway shall be provided in each motor control center section that accepts modular plug-in units. The vertical wireway shall connect with both the top

and bottom horizontal wireways. The vertical wireway shall be barriered from control units and have a separate hinged door.

8. Unused spaces and spares shall have hinged doors.

D. Bussing:

1. Provide complete horizontal and vertical bussing with wiring spaces at top, bottom, and vertically in each section. All bussing shall be silver plated 98 percent conductivity copper.
2. The main horizontal bus shall be fully rated and shall extend the full length of the motor control center. Include provisions for splicing additional sections onto either end of the motor control center.
3. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and shall be rated no less than 125 percent of motor FLA in that section. Vertical bus shall extend full height of section, including all spare and space units. For purposes of calculating vertical bus ampacity, each space shall count no less than FLA of smallest motor served in that section.
4. A tin or silver plated copper ground bus shall be provided that runs the entire length of the motor control center. The ground bus shall be rated no less than 1/3 of horizontal main bus amps. Provide a vertical ground bus in each section used for plug-in units. Plug-in units shall have a ground stab arranged for first-make, last-break relative to the power bus stabs.
5. Motor control centers shall be separated into shipping blocks of no more than three vertical sections each.
6. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be isolated from the horizontal wireways and starters. Barriers shall be removable to allow access to the bus and connections for maintenance.
7. The vertical bus shall be housed in modular glass filled polyester supports that provide bus insulation. These supports shall have openings every three (3) inches for unit stab-on connections. Each opening shall be provided with a closing plug to close off the stab opening.

E. Terminations:

1. Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
2. All starter units shall be provided with unit control terminal blocks.
3. Terminal blocks shall be the pull-apart type rated at 20 amps. The stationary portion shall be used for field connections and will remain attached to the cubicle when the unit is removed. The removable portion of the terminal blocks shall be used for the unit wiring factory connections.

F. Protective Devices:

1. Class J Fusible Switch-Starter Units: Plug in type with silver plated pressure type line disconnecting stabs of high strength copper alloy. Each unit shall be totally enclosed and effectively barriered, and shall be so designed that it can be located anywhere within the structure using the same overload heaters for the same load. Fusible switches shall be manually operated quick make, quick break, horsepower rated. Coordinate fuses and overload heaters for proper acceleration time of motors provided. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by 1 to 3 padlocks. Provide Class J fuse clips. Provide

- magnetic starter components as specified in Article MOTOR CONTROLLERS. Provide fuses field-installed in accordance with Article FUSES.
2. Circuit Breakers (with no motor controller): Molded case, bolted type, quick make, quick break, trip free, common thermal magnetic trips. Operating handle shall clearly indicate ON or OFF. Means shall be provided for locking each breaker in OFF position by one to three padlocks. Automatic tripping indicated by handle at center position.
 3. Fused Switch (with no motor controller): Quick make, quick break, horsepower rated. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by one to three padlocks. Provide Class J Type fuse clips. Provide fuses in accordance to Article FUSES located in this section.
 4. Starters: all starters for motor control center to be size 1 minimum or larger.
- G. Short Circuit Current Ratings:
1. Protective devices, together with the bussing and bracing, shall safely and without failure withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage. Provide higher ratings when indicated on the Drawings.
 2. Bus bracing shall be provided for the entire bus network to withstand the mechanical forces generated during the specified short circuit.
 3. The main device serving the motor control center, every motor control unit and other overcurrent devices installed in the motor control center shall have an interrupt rating no less than the specified short circuit.
 4. The entire motor control center shall be suitable for operation at the specified available fault current. The motor control center shall be labeled by the manufacturer to indicate the maximum available fault current rating, taking into account the structure, bussing, main feeder and all units and devices included in the motor control center. This fault current withstand rating shall be the basis for the UL Short-Circuit Current Rating.
- H. Nameplate:
1. Identify each device with nameplate showing load served. Refer to "Labeling" in Section 16050.
 2. Provide a master nameplate on face of units similar to following, with correct data shown:

Motor Control Center
480 Volts, 3 Phase, 3 Wire, 60 Hertz
Main Bus: ____amps. braced for ____ amperes RMS Symmetrical
Date Installed:
 3. Provide a nameplate for each vertical section marked with section characteristics and factory identification. This nameplate may be manufacturer's standard construction.
 4. Provide UL listing marks on each section and unit in manufacturer's standard format.
- I. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions
 3. Cable Termination Provisions
 4. Current Ratings
 5. Voltage Ratings
 6. Short Circuit Ratings including proof of any UL-listed series ratings (if series rating allowed by specification).

7. Motor Controller and Protective Device Ratings, including catalog pages for all current-limiting devices.
8. Identify NEMA Class of submitted mcc.
9. Identify NEMA Wiring Type of submitted mcc.
10. Single Phase Relay
11. Unit Elevation
12. Bussing Schematic, Sizes and statement of Conductor and Plating Material.
13. Original Manufacturer Brochure and Specifications

2.14 MAIN SWITCHBOARDS:

- A. General: Provide universal building-type switchboards fabricated in accordance with NEMA Standard PB-2, UL Standard 891, and bearing a UL Service Entrance Label. Switchboard characteristics are 480/277 volts, 3 phase, 4 wire. Main connection and unit-mounted branch connections shall be from the rear. Group mounted branch connections shall be from the front or the rear. The entire switchboard assembly shall be similar to Square D Type QED-2.
- B. Structure:
 1. The switchboard shall be freestanding and have front and rear alignment. Provide rear access to main device(s) and all unit-mount branch devices (2000A and less can be front access only). Provide front or rear access to group-mounted devices. Formed up steel channels bolted together to form a rigid structure to which formed up fronts, side sheets, and rear covers are bolted. Galvanized 1-1/2" x 3" mounting channels on bottom, rear, left, and right sides to close all openings at the bottom. Arrange for easy addition of future cubicles at end. Provide pull box, fabricated with unit at factory, on top of switchboard if required for proper entrances and exits of feeders.
 2. When "SPACE" is indicated on one-line diagram, provide full bussing extension to serve that space and all overcurrent device mounting hardware for the given frame size.
- C. Installation: Freestanding, level and bolted to a four (4) inch concrete pad.
- D. Instrumentation:
 1. General: Monitor the incoming line with a Square D PM 5563 meter with BACnet IP communication port protocol.
Meter shall have digital display adjustable to select phase. Monitor with an ammeter any feeder devices indicated on the Drawings.
 2. Wiring Lugs: Provide ring lugs for all wiring terminations of potential transformers (PTs), current transformers (CTs) and current sensors. Fork lugs are not acceptable. Ring lugs are intended to minimize the chance of leads pulling apart and creating an open circuit. (Zero current reading).

- E. Phase, Neutral and Ground Bussing: Silver plated 98% conductivity copper sized to comply with NEMA Temperature Rise Standard. In addition, copper bus shall be sized on the basis of a maximum temperature rise of 65 degree C. The vertical bussing per cubicle shall be sized not less than the sum of all devices, including spare spaces, to be served from that cubicle. **The vertical bus shall be a minimum of 2000 amperes and shall be full height.** Bus supports, connections, and joints shall be bolted with SAE Grade 5 medium carbon steel bolts employing Belleville washers. Provide complete bussing, mounting provisions for circuit protective devices and space screw cover wherever the drawings indicate space only. Arrange and drill bussing for **future full capacity extension.** Provide a full length ground bus, with minimum ampacity of 1/3 phase bus ampacity. Provide full-size neutral rated at 100 percent of phase bus.
- F. Terminations: Provide proper incoming line lugs to accommodate cable shown on plans.
- G. Short Circuit Ratings:
1. Switchboard assembly of protective devices, together with the bussing and bracing, shall be fully-rated to withstand and interrupt short circuits on a system capable of delivering up to 65,000 (or 100,000) amps RMS symmetrical at nominal system voltage.
- H. Provisions for Auto Power Factor Controller (APFC):
1. Provide a circuit breaker with adjustable electronic tripping to protect and disconnect the automatic power factor controller.
 2. Set amp trip at minimum 150 percent of ampacity for the actual KVAR installed.
 3. Provide buss CTs on main incoming buss for use by the remote auto pf controller. These CTs shall be separate and in addition to all other CTs required for switchboard metering. Install a shorting terminal block on CT until the auto pf controller is installed at the job site.
 4. Refer to Section 26 35 33 for additional requirements of auto pf controller.
- I. Protective Devices:
1. Switchboard Main Breaker:
 - a. Stationary mounted, manually operated, 100 percent rated molded case circuit breakers with electronic tripping system and stored energy closing mechanisms. The electronic tripping system shall be similar to Square D Micrologic Full Function Trip unit. Main breakers shall be Square D NW (3000-4000) ampere frame size.
 - b. The breaker shall be UL Listed for continuous duty at 100% of the current rating.
 - c. Minimum interrupting rating of 65,000 amperes rms symmetrical at 480/277 Volts.
 - d. Local trip indicators: overload, short circuit and ground fault.
 - e. Electronic sensing systems shall be true-RMS sensing and not susceptible to adverse harmonic current effects.
 - f. Adjustments:
 - 1) The electronic trip unit shall have LSIG Trip functions.
 2. Feeder Devices:
 - a. Breakers 700 Amps and Larger:

- 1) Branch feeder breakers 700 amp and larger shall be molded case circuit breakers rated 100% with electronic trip units, similar to Square D [NW (3000-4000A)].
 - 2) Interrupting rating shall be at least 65,000 amperes rms symmetrical at 480/277 Volts.
 - 3) The electronic trip unit shall have LSI trip functions.
 - 4) The breaker shall be UL Listed for continuous duty at 100% of the current rating.
 - b. Breakers 600 amps and smaller shall be type L (600A and 400A frame), J (250A frame), and H (150A frame) molded circuit breakers, AIC rating to match main breaker.
 - c. The breaker shall be UL Listed for continuous duty at 100% of the current rating
- J. Transient Voltage Surge Suppressor (TVSS):
1. General: Provide a Square D Class 1310 240kA surge current rated mounted in the switchboard mounted above the main circuit breaker compartment.
- K. Lightning and Overvoltage Surge Arrester:
1. General: Provide a Square D SDSA3650 lightning and overvoltage surge arrester inside the switchboard housing, connected between the service entrance bussing and the ground bus.
 2. Description: Device shall be a heavy duty, three-phase, zinc metal oxide varistor (MOV), secondary class arrester rated for 650 volts and U.L. listed in Category (OWHX) of the Electrical Construction Materials Directory (Green Book). Device shall comply with ANSI/IEEE C62.11-1987 Standard for Metal Oxide Surge Arresters for AC Power Circuits.
 3. Installation shall comply with NEC Article 280. Provide fusing if required by installation instructions from arrester manufacturer.
- L. Identification:
1. General: Identify each device and meter with a nameplate showing load served. Refer to Article on LABELING in Section 26 05 00.
 2. Master Nameplate: Provide a master nameplate on face of boards similar to following, with correct data shown:

Main Switchboard _____
480/277 Volts, 3 Phase, 4 Wire, 60 Hertz
Main Bus: ___amps. braced for ___ RMS sym. amps.
Date Installed: _____
- M. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions
 3. Cable Termination Provisions
 4. Current Ratings
 5. Voltage Ratings
 6. Short Circuit Ratings
 7. Protective Device Ratings
 8. Electronic metering system

9. Surge Arrester
10. Unit Elevation
11. Bussing Schematic, Sizes and Statement of Conductor and Plating Materials
12. Original Manufacturer Brochure and Specifications
13. Coordination drawing using dimensions of actual switchboard submitted. Show board footprint, proper clearances, and other equipment in same room.

N. Testing: Test all devices and systems to assure proper operation.

2.15 SERVICE ENTRANCE CABLE TAP BOX (CTB):

A. Cable Tap Box:

1. General: Provide weatherproof, freestanding phase collection and cable tap box. Fabricate in strict accordance with Electric Utility requirements. Line side connection from building pad-mounted transformer shall be through underground conduit and wire, load side connections to the building main switchboard(s) shall be weatherproof outdoor busway.
2. Structure: Formed up steel channels bolted together to form a rigid structure to which formed-up fronts, side sheets, and rear covers are bolted. Front and rear doors shall be hinged. Galvanized 1-1/2 inch x 4 inches mounting channels on bottom, rear left, and right sides to close all side openings at the bottom. Interior framing shall be galvanized steel 1-5/8" rigid channel or approved equal system. Enclosure shall be tamper proof and outdoor weatherproof.
3. Installation: Freestanding and level on an outdoor concrete pad. Provide anchor bolts. Pad shall be outside all Electric Utility easements. Stub up conduits for Electric Utility service lateral and customer-side service entrance conduits. All underground conduit to/from CTB shall be concrete-encased.
4. Bussing: Insulated bussing, silver plated 98 percent conductivity copper. Bussing shall be sized in accordance with UL and NEMA Standards. In addition, size copper bus for not more than 1000 Amperes per cubic inch current density. Provide 3 phase, 4 wire, (100 percent neutral) bussing. Install with rigid supports to meet fault current rating.
5. Fault Current Rating: Bussing and bracing shall safely and without failure withstand short circuits on a system capable of delivering up to 100,000 amperes rms symmetrical at nominal system voltage. Install rope tie as required after cable installation to maintain bracing for short circuit current rating.

B. Electric Utility Requirements:

1. Prior to fabrication, submit three (3) prints of proposed cable tap box (CTB) to the representative designated by the Electric Utility. Submit prints only after shop drawings have been submitted and review cycle is complete with the Architect. Allow at least eight weeks time for review by Electric Utility prior to desired date of new service cut-in. Allow additional time for Architect/Engineer review prior to submittal to Electric Utility.
2. Cable tap box enclosure shall be tamper proof and weatherproof. Entire cabinet shall be tamper-resistant.
3. Form roof with cross-kink to force water to run off the cabinet.
4. Paint Finish Color: Match color of Electric Utility padmount transformer. Minimum finish shall be prime coat plus at least 6 mils of finish coat paint in two (2) applications.
5. Provide full-height doors on both utility side and customer side. Each door shall be hinged and have a vault-style handle with padlocking provisions. Electric Utility will

- install its padlock. Provide weatherproof padlock on customer door and give Owner ten (10) copies of key.
6. Fabricate CTB with two separate compartments; one side for Electric Utility connections and the opposite side for Customer connections. Compartments shall be separated with an insulating barrier. Size cabinet to maintain necessary wire bending radius in Electric Utility and Customer compartments.
 7. All insulating barriers shall be one (1) inch black phenolic resin, NEMA Grade N-1 or XX, or phenolite (Grade GPO-3).
 8. Each bus bar shall be copper, minimum 1/4 inch x 4 inches. Drill and tap for six (6) sets of 2-hole compression lugs per bus bar on Electric Utility side or other configuration stipulated by E.U. Lowest edge of all bus bars shall be 36 inches above top of concrete foundation. All bus bar dimensions, quantities, bracing and exact layout shall be per approved details from the Electric Utility for this specific job site. Parallel sufficient bus bars to achieve ampacity shown on Electrical Drawings for both Electric Utility and Customer side of CTB. Drill and tap for 2-hole NEMA D-tang compression lugs for termination of Customer cables.
 9. Install CTB level and bolted to a concrete foundation. Locate outside work space clearance and easements associated with Electric Utility padmount transformer and primary ductbank.
 10. Cable Termination: Terminate all cables with NEMA-pattern, two-hole, compression lugs.
- C. Submittal to A/E: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions: plan, elevations, bus bars.
 3. Cable Termination Provisions
 4. Current Rating
 5. Voltage Rating
 6. Short Circuit Withstand Rating
 7. Bussing Sizes, Layout and Statement of Conductor and Plating Materials
 8. Certify weatherproof cabinet construction. Certify paint finish type and thickness.
 9. Coordination Drawing showing cable tap box, Electric Utility padmount transformer with required work space clearances, meter location, and underground conduit entrances.
 10. After A/E shop drawing cycle is complete, submit three complete copies to Electric Utility.

2.16 SEQUENCING PANELBOARD FOR THEATER SOUND REINFORCEMENT SYSTEM:

- A. Features:
1. Supply all ac circuits for audio/visual equipment in the high school theater A/V room from time sequence panelboard capable of being remote controlled from multiple locations.
 2. 41 sequenced circuits per panelboard.
 3. A means of visual operator feedback shall provide an indication of the progress of the power turn-on and turn-off sequence at each control point.
 4. Sequencing shall have an adjustable time delay between the low level equipment circuits and the power amplifier circuits.
 5. The sequencing system shall be capable of shedding the load within three (3) seconds after a power failuer and re-sequencing when power resumes without operator intervention.
 6. Provide one LynTec Cat. No. SS-2 Sequencer Switch Set with every 41-circuit panelboard.

7. Provide one LynTec Cat. No. SS-2PL Remote Locking Switch Plate with every 41-circuit panelboard.
 8. Provide for each sequencing panelboard a LynTec Model No. SLC 341-41 filled with MB-Motorized Breakers, 3 phase, 4 wire, 208Y/120 Volt 225 Amp Main Breaker panel or approved equal.
 9. Acceptable Manufacturer: LynTec Inc., 8401 Melrose, Lenexa, KS 66214-1647; telephone 800-724-4047, fax 888-722-4157, www.lyntec.com or email info@lyntec.com.
- B. Cabinet: Safety dead front type; box made of Code gage galvanized steel; minimum gutter space 4" on all sides but not less than NEC requirements; door with flush type latch. Enclosure shall conform to NEMA 1.
- C. Circuit Breakers:
1. General: Provide a breaker for each audio branch circuit to protect wiring and equipment served.
 2. Description: Each breaker shall have motor drive for individual breaker remote control. Breakers shall be quick make, quick break, trip free, thermal magnetic trip. Automatic trip shall be indicated by the handle at the midpoint position. Multiple pole breakers shall have common trip.
- D. Short Circuit Ratings: 120/208 volt systems 10,000 amperes RMS symmetrical.
- E. Phase, Neutral and Ground Bussing: Silver or tin plated 98 percent conductivity copper sized in accordance with NEMA Temperature Rise Standards and installed completely throughout panel for installation of future breakers where schedule shows space only. Provide an equipment grounding bus bonded to the panel cabinet. Ground bus shall have a terminal screw for every breaker in the panel.
- F. Termination: Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
- G. Surge Protective Device: Install a Transient Voltage Surge Suppressor (TVSS) on the sequencing panelboard. TVSS shall be Current Technology TransGuard TG60 Series or Liebert Interceptor Model 111 Series.
- H. Nameplate: Nameplate on front face showing panel name and voltage. Coordinate to give same name as shown on Drawings.
- I. Directory: Complete at end of job, typewritten, contained in frame on the inside of the panel door. Frame shall have a protective plastic shield. Label every breaker to match directory.

2.17 ELEVATOR SHUNT TRIP DISCONNECT

- A. Provide Bussman Power Module Switch PS Series; amperage size and operating voltage shall match elevator branch circuit indicated on drawings.
- B. Provide control power transformer, fire alarm system interface relay, key-to-test switch, mechanical interlock auxiliary contact for hydraulic elevators with automatic recall.
- C. Interconnect with local heat detectors to provide elevator shutdown prior to the discharge of fire protection water in elevator machine room.

PART 3 - EXECUTION

3.1 MOUNTING:

- A. General: All equipment shall be securely fastened in place.
- B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.
- C. Concrete Pads:
 - 1. Provide concrete in accordance with the Division of the Specifications for that product.
 - 2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
 - 3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.
- D. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.
- E. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

3.2 DELIVERY, STORAGE AND HANDLING:

- A. General:
 - 1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
 - 2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
 - 3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
 - 4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
 - 5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.
- B. Approved Conditions for Equipment Storage:

1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
 2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
 - a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
 - b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
 - c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
 - d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.
- C. Transformer
1. Indoor storage shall be provided for all transformers.

3.3 GROUND FAULT PROTECTION OF EQUIPMENT:

- A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

3.4 TRANSFORMER VIBRATION ISOLATION:

- A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.
- B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.
- C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.
- D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

3.5 TRANSFORMER VENTILATION:

- A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

3.6 POWER SHUT OFF UNDER KITCHEN HOODS:

- A. NFPA:
 - 1. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment requiring protection by that extinguishing system.
 - 2. Comply with NFPA 17, Standard for Dry Chemical Extinguishing Systems.
 - 3. Comply with NFPA 17A, Standard for Wet Chemical Extinguishing Systems.
- B. Shunt Trip: All electrical sources located under the ventilating equipment (cooking equipment hood) shall be shut off upon the operation of a wet chemical or water fire extinguishing system. Provide shunt trip accessory on each circuit breaker serving an electrical appliance under the hood. Install control wiring between shunt trips and the hood extinguishing system. coordinate all wiring with supplier of hood fire suppression system for proper selection of shunt trip coil voltage, momentary or maintained-contact closure to activate shunt trip and inter-connections. Operation of a hood extinguishing system shall automatically shunt trip all associated circuit breakers.
- C. Fire Alarm System: The operation of any extinguishing system shall automatically signal the building fire alarm system. Refer to Section 26 05 53 for additional fire alarm system requirements.

3.7 LABELING:

- A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

END OF SECTION 26 20 00

SECTION 26 27 26 - WIRING DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.3 REFERENCES

- A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
- B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.
- C. Minimum Raceway Size: 3/4 inch.

1.4 SUBMITTALS

- A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

2.2 WALL SWITCHES

- A. Single Pole Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V.
- B. Double Pole Switch, Toggle Style:
 - 1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.
- C. Three-way Switch, Toggle Style:
 - 1. Leviton 1223 Series, 20A, 120/277V.
- D. Four-way Switch, Toggle Style:
 - 1. Leviton 1224 Series, 20A, 120/277V.

- E. Indicator Switch, Toggle Style:
 - 1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.
- F. Locator Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.
- G. Digital Time Switch:
 - 1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.
- H. Key lock switches:
 - 1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
 - 2. 20 Amp rated.
 - 3. 120/277 Volt ac rated.
 - 4. Key-lock mechanism can only be turned ON or OFF with key.
 - 5. Single pole: Leviton 1221-2KL or approved equal.
 - 6. 3-Way: Leviton 1223-2kl or approved equal.
 - 7. 4-Way: Leviton 1224-2kl or approved equal.
 - 8. Provide 302 stainless steel wall plate for each switch.
 - 9. Provide 2 keys on ring for each switch.
 - 10. Include a brass tag on every key switch ring. Engrave tag; Example: "Hall East Lights".
 - 11. Key all switches alike to match the owners standard key. Coordinate with school District for key match.
- I. Color: As selected by Architect.

2.3 MOTOR RATED SWITCHES

- A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.
- B. Leviton MMS Series.

2.4 WALL DIMMERS

- A. Manufacturers:
 - 1. Lutron Nova "T" Series.
- B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.
- C. Body and Handle: Linear slide handle, color as selected by Architect.
- D. Voltage: 120 volts.

2.5 RECEPTACLES

- A. Single Convenience Receptacle:
 - 1. Leviton 5362A Series, 20A/125V.

- B. Duplex Convenience Receptacle:
 - 1. Leviton 5362 Series, 20A/125V, respectively.
- C. GFCI Receptacle:
 - 1. Leviton 7899 Series, 20A/125V.
 - 2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).
- D. Isolated Ground Duplex Receptacle:
 - 1. Leviton 5362-IG, 20A/125V.
- E. Duplex Tamper Resistant Receptacle/ USB Charger
 - 1. Leviton T5832. Duplex 20A/125V receptacle with two 3.6A, 5VDC, 2.0 Type A USB Chargers.
- F. Provide 20 amp receptacle for single-receptacle branch circuits.
- G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.
- H. Color: As selected by Architect.

2.6 WALL PLATES

- A. Type 302 Stainless Steel with matching mounting screws.

2.7 MANUFACTURERS

- A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
 - 1. Leviton
 - 2. Pass & Seymour
 - 3. Hubbell / Bryant
 - 4. Cooper

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.
- B. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Route raceway and cable to meet Project conditions.
- B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

- C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.
- D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.
- E. Install devices plumb and level.

3.3 MOUNTING HEIGHTS

- A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

- A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.
- B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.
- C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

- A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

END OF SECTION 26 27 26

SECTION 26 32 13 - EMERGENCY GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide an emergency power system for emergency egress lighting, fire alarm system, emergency elevator operation, and other emergency power loads required.
- B. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.
- C. Products supplied but not installed under this section. Products shall be turned over to the Owner.
 - 1. Emergency generator system equipment as follows:
 - a. Complete set of all special tools required to operate and service the equipment as recommended by the manufacturer for field maintenance.
 - b. One oil filter replaceable element.
 - c. One air filter replaceable element.
- D. Related Sections:
 - 1. Division 1 - General Requirements
 - 2. Applicable sections of Division 16 - Electrical
 - 3. For emergency generators: Fuel gas piping, exhaust gas piping, flexible pipe connections, cooling air duct work, assembling generator accessories.
- E. Power Source: Provide an on-site engine-generator set to generate power for distribution to emergency and standby loads by the emergency power distribution system. Engine-generator set shall be constructed of all-new components.
- F. Transfer: Power to emergency loads shall be automatically transferred from normal utility power to the emergency engine generator upon loss of normal power. Transfer and assumption of load shall occur in ten (10) seconds or less. Loads shall be automatically retransferred upon restoration of normal source.
- G. Distribution System: Distribution equipment devices, and circuits shall be provided as required to distribute power to emergency loads.

1.3 REFERENCES

- A. Emergency generators shall be in accordance with the latest applicable standards as recommended by, SAE, IEEE, and ANSI/NEMA MG-1 Motors and Generators.

1.4 SUBMITTALS

- A. Shop Drawings:
1. Emergency generator systems including:
 - a. Engine-generator set and foundation requirements.
 - b. Auxiliary and remote equipment.
 - c. Make of engine, number of cylinders, compression ratio, bore and stroke, cylinder displacement, and speed.
 - d. Make of generator, electrical rating, number and type of bearings, and exciter type.
 2. Plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
 3. Product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer and vibration isolators.
 4. Installation instructions.
 5. Name, location and phone number of nearest authorized distributor/service facility.
 6. Sequence of Operation - Manufacturer shall prepare a detailed, typewritten sequence of operation and submit as part of the approval documents. Final approved sequence of operation shall be permanently encapsulated in plastic laminate and permanently attached to the equipment. Format shall be 8½" x 11" or 11" x 17" as appropriate.
 7. Include schematic one-line diagram with appropriate symbols and nomenclature properly referenced to text.
- B. Product Data:
1. Specification Review: A complete item by item, line by line specification review.
 2. Output current Amperes and electrical kW rating of engine-generator set.
 3. Brake horsepower rating of engine.
 4. Fuel consumption at 100 percent, 75 percent and 50 percent load.
 5. Cooling requirements.
 6. Sound level (dBA measured on longitudinal and perpendicular axis at ten (10) feet).
 7. Manufacturer's technical data for generator, governor, voltage regulator, and battery charger. Governor submittal shall also identify method of overspeed protection to be furnished.
 8. Generator sub-transient reactance X_d'' , per unit
 9. Generator short circuit current, three-phase amperes.
 10. Generator voltage waveform distortion, measured at Full Load, line-neutral, both total harmonic distortion (THD) and maxim single harmonic order THD.
 11. Generator output circuit breaker(s), including proof or UL listing.
 12. Transfer Switch: Show complete data showing compliance. Include continuous and withstand current ratings of all contacts.
- C. Manuals and Test Data
1. Operation and Maintenance Manuals for all major components including instructions for normal operation, routine maintenance requirements, service manuals for generator, engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.5 QUALITY ASSURANCE

- A. Authority Having Jurisdiction:
 - 1. General: The system shall comply with all applicable Codes and Ordinances as interpreted and enforced by the local authority having jurisdiction.
- B. National Electrical Code: The system shall comply with NFPA 70, National Electrical Code, including: 1) Article 445, 2) 700.
- C. NFPA:
 - 1. General: Comply with applicable requirements of NFPA Standards, including the following:
 - a. NFPA 37: Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - b. NFPA 101: Life Safety Code.
 - c. NFPA 110: Standard for Emergency and Standby Power Systems.
 - 1) Type ten (10) seconds.
 - 2) Natural gas utility pipeline
 - 3) Category B (engine-generator set).
 - 4) Level 1
 - d. NFPA 54: National Fuel Gas Code.
- D. UL:
 - 1. General: Comply with applicable requirements of UL Standards, including the following.
 - a. UL 1008: Automatic Transfer Switches, Fourth Edition or later.
 - b. ANSI / NEMA: Comply with applicable requirements of ANSI / NEMA MG 1, "Motors and Generators", and MG 2, "Safety and Use of Electric Motors and Generators".
 - c. IEEE: Comply with applicable portions of IEEE Std 446-1987, "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications" (Orange Book)
- E. EPA:
 - 1. General: Comply with all applicable EPA requirements.

1.6 OWNER'S INSTRUCTIONS

- A. Provide a four (4) hour period of instruction to the Owner's designated personnel upon completion of the system installation. Run engine-generator set and review remote annunciator panel for typical readings. Explain operation of generator remote stop switch. Demonstrate complete transfer sequence of utility-generator-utility. Operations & Maintenance Manual shall be complete and on-site for use during Owner's Instruction.

1.7 WARRANTY

- A. Furnish full parts and labor warranty to cover the entire engine generator package and automatic transfer switch including all accessories, components, controls, batteries, etc. for five years. Warranty shall begin from date of Certificate of Substantial Completion. Provide a sample of manufacturer's warranty certificates within equipment submittal. Warranty start dates from shipment or start up will not be accepted.

- B. In addition to full parts, labor, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, oils, lubricants, belts, filters, etc. and any expenses related to service calls required to diagnose and correct warranty issues. No purchase order number shall be required by the owner for service calls within warranty period. Purchase order number can be issued after problem is determined not to be a warranty issue.
- C. The manufacturer shall provide factory certificates for each Generator and associated Automatic Transfer Switch listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- D. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing contractor.

1.8 MAINTENANCE

- A. Furnish one set of tools required for preventative maintenance of each engine generator system. Package tools in adequately sized metal tool box.
- B. Provide two spare sets of each oil, and air filter element required for each engine generator system.

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

- A. Furnish and install new natural gas engine driven electric generating unit, factory assembled single unit generator set, with continuous output voltage of 480Y/277, 3 phase, 4 wire, at 0.8 power factor, 60 hertz, grounded neutral service, fully rated for operation at the job site altitude at an ambient temperature range of 120 degrees Fahrenheit maximum to -0 degrees Fahrenheit minimum, all mounted on a common steel base suitable for mounting on a concrete foundation pad, complete with a derangement panel and all accessories as specified and required for normal operation in standby service.
- B. Acceptable Manufacturers:
 - 1. Caterpillar
 - 2. Cummins/Onan
 - 3. Kohler
- C. Manual and Automatic Start - Unattended Operation
 - 1. Manual start shall be done by operating the "start" button on the generator or selecting "manual" on the manual-off-automatic selector switch on the automatic transfer switch.
 - 2. Automatic start shall be done by the automatic transfer switch when the manual-off-automatic selector switch on the automatic transfer switch is in the "automatic" position.
- D. Voltage and frequency regulation.
 - 1. Engine/generator shall deliver rated output (kVA) at rated frequency and power factor, at not more than two (2) percent above or below rated voltage.
 - 2. Voltage regulation shall be plus or minus two (2) percent for any constant load between no load and rated load. Random voltage variation shall not exceed ± 1 percent for any constant load. Voltage recovery to 100 percent normal output

- shall take no longer than two seconds after single step application of 100 percent rated load.
3. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 1.8 hertz. Frequency adjustable from 57 hertz to 63 hertz (± 5 percent)
 4. The engine-generator set shall be capable of single step load pick up of 100 percent nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- E. The alternator shall produce a clean AC voltage waveform, with not more than five (5) percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than three (3) percent in any single harmonic.
- F. Furnish all necessary electrical connections, transfer switch, control panel, relays, etc., for installation of new generator set.
- G. Generator and engine shall be mounted on vibration isolating supports capable of 95 percent isolation to minimize vibration of the remainder of the skid-mounted equipment and transmission of vibration to the supporting pad.
- H. Generator shall be fully enclosed or suitably guarded to prevent exposure to all parts which operate at extremely high temperatures, electrically energized, or rotating. All noncurrent carrying parts shall be grounded.
- I. Thoroughly clean all equipment, and prime and finish paint with manufacturer's standard paint finish.
- J. Outdoor Weather-Protective Housing: Factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation and exclude entry of moisture into interior components. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color.

Specifier's Note: Edit for Diesel Engines.

2.2 ENGINE

- A. Engine shall be standby power rated, multi-cylinder, spark ignited four stroke cycle, liquid cooled, internal combustion engine for use with natural gas fuel, industrial type, designed for full rated power output at 1800 rpm, 60 hertz. The engine shall be arranged for direct connection to the alternating current generator.
- B. Governor shall be electronic isochronous type no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Random frequency variation shall not exceed $\pm 0.25\%$ of its mean value for constant loads from no load to full load. Governor shall be provided with means for manual operation and adjustment.
- C. Lubrication system.
1. Full pressure type with engine driven positive displacement sump pump,
 2. Full flow strainer,
 3. Full flow filter,

4. Pressure relief and automatic bypass valves,
 5. Crankcase ventilator with filter and connection for outside venting,
 6. Bayonet type oil level indicating pressure gauges on the upstream and downstream side of the strainer and filter,
 7. Drain connection,
 8. Oil cooler,
 9. Low oil pressure safety shutoff device,
 10. Provide water shutoff valves and drain on the oil cooler to facilitate draining water without draining the complete engine cooling system.
 11. Provide a radiator coolant level sight glass.
- D. Cooling system.
1. Pressure type, with radiator, blower type fan,
 2. Engine driven circulating pump,
 3. Radiator cap incorporating a pressure-vacuum valve,
 4. Thermostat in conjunction with a radiator bypass,
 5. Drain connection,
 6. High coolant temperature safety device,
 7. Fan shall be sized to maintain safe engine temperature in ambient temperature of 120 degrees Fahrenheit,
 8. Provide gaskets and packing in the cooling system which are unaffected by ethylene glycol base coolant,
 9. Provide a 50% ethylene glycol antifreeze solution for the coolant,
 10. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct for directing discharge air through the wall,
 11. Radiator and Air Intake/Discharge System Flow Restriction requirement shall be no less than 0.5 inches of water.
- E. Provide thermal circulation type engine jacket water heater with integral thermostatic control, sized to maintain minimum coolant temperature of 49 degrees Celsius down to an ambient temperature or 0 degrees Celsius. The heater shall be disconnected whenever the engine starts by an oil pressure switch mounted on engine. Connect heater to 120 volt normal power panel as indicated on Drawings. Install tag at connection on generator to identify power panel and circuit number.
- F. Air intake system shall be complete with a dry type filter, and high frequency filter-type silencer for reducing the sound level at the intake to a point acceptable for residential use.
- G. Air shutoff for emergency shutdown.
- H. Engine exhaust system shall be complete with stainless steel critical type silencer capable of reducing ambient exhaust noise level to 60 dBA when measured 50 feet from the engine under full engine load and clear weather. Silencer shall be supported independently of the engine. Flexible exhaust connection shall be provided from the engine exhaust manifold to the silencer. An exhaust condensation trap with manual drain valve shall be provided to prevent condensation from entering the engine. Furnish and install a steel rain cap at the exhaust stack outlet. Rain cap shall have a high-temp paint finish.
- I. Standard SAE nuts, bolts, and studs.
- J. Standard NPT or SAE tubing and fittings.

- L. Gas Train for Natural Gas Fuel System:
1. General: Provide all fuel system components necessary to allow the generator system to operate under continuous emergency full load. Gas regulator train assembly shall be designed for engine manufacturer's recommended gas pressure from a nominal five (5) pound per-square-inch natural gas service. Install components furnished with engine.
 2. Engine-mounted carburetor.
 3. Fuel gas pressure regulators with vibration isolating, flexible fuel line joint on gas-supply side.
 4. Solenoid valve that automatically shuts off flow of gas if the engine stops for any reason. Install this valve on gas-supply side of gas pressure regulator.
 5. Gas pressure gauge with analog display of ounces-per-square-inch to monitor gas supply pressure. Install this gauge in gas train inside the generator set housing.
 6. Gas line service regulator with atmospheric vent.
 7. Dry filter for vapor withdrawal.
 8. Manual shut-off valve.
 9. Gas surge tank or other components as may be recommended by engine supplier.
 10. Gas fuel line for Emergency Power System shall be connected ahead of the main gas shutoff valve for the building with a separate, dedicated shutoff valve. Mark both generator gas valve and building gas valve with permanent signs to indicate that there is another valve, per NFPA 110, sect. 5-9.7.

2.3 GENERATOR

- A. Generator shall be alternating current, three phase, four pole, reconnectible brushless revolving field synchronous type with brushless exciter directly connected to the generator field windings without slip rings or commutators.
- B. Generator shall have a single prelubricated sealed bearing, direct connected to the engine, by means of a flexible disc coupling for self-alignment and air cooled by a direct drive centrifugal blower fan.
- C. Insulation shall be minimum Class F in a self-ventilated enclosure. Temperature rise shall be 130 degrees Celsius max over ANSI 40 degrees Celsius ambient for standby service.
- D. Bring out all leads from each winding to a generator main lead terminal box adequate in size for making up all connections and grounding the neutral to the generator set supporting frame.
- E. Voltage regulation shall include True RMS 3 phase sensing, generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics. Include manual controls to adjust voltage output plus or minus 5 percent of nominal voltage level.
- F. The generator shall have the necessary excitation control circuitry to prevent the loss of excitation on fault conditions allowing quick return to full voltage and power to normal and faulted circuits.
- G. Furnish NEMA 1 output terminal and outgoing cable termination compartment integral with the engine-generator frame.

- H. Output Breakers: Provide output molded case circuit breakers of adequate capacity and rating. Provide output breaker for each output circuit running from generator. Breaker shall be UL Listed 100 percent rated for continuous operation at full ampacity. Provide cable extensions and enclosure required to integrally mount output circuit breaker inside outdoor generator housing. Enclosure shall comply with NEC 404-3.
- I. Housing Alternator shall have an open drip-proof construction.

2.4 VOLTAGE REGULATION

- A. Static type, three phase, mounted either on the generator control panel or combined with the exciter. Voltage shall have "manual-automatic" switch and be adjustable +/- 10 percent under all operating conditions.

2.5 ELECTRIC STARTING SYSTEM

- A. Engine starting system shall be a 12 volt or 24 volt DC system depending on size of engine/generator, consisting of a heavy duty electric cranking motor(s) with drive mechanism, heavy duty batteries with metal frame or box, engine driven alternator, battery charger, and transistorized voltage regulator.
- B. Cranking motor shall be capable of starting the engine five times in rapid succession without overheating the motor and at sufficient speed for starting in low ambient temperatures.
- C. Storage batteries shall be lead acid type of voltage and capacity as determined by the engine manufacturer, with sufficient capacity to start the generator set five times consecutively in rapid succession. Provide all battery cables and connections. Provide hydrometer.
- D. Battery charger shall be an automatic, self-protected, self-regulated, dual rate rectifier type of a capacity determined by the engine manufacturer and sufficient to automatically recharge the batteries quickly according to the requirements governed by battery discharge duty, and suitable for 120 volt, single phase, 60 hertz input service from a remote receptacle panel.

2.6 ENGINE-GENERATOR CONTROL PANEL

- A. Control panel shall be engine generator frame mounted in NEMA 1 enclosure, totally front accessible. Control panel shall be completely factory pre-wired. All external connections shall be wired out to terminal blocks for field wiring. Control panel shall be complete with all engine and generator controls and indicators. Include front hinged double doors with latches and provision for padlock.
- B. Control panel shall provide a contact closure to initiate operation of the ventilation system. Wire out to terminal block. Contact shall be field wired by manufacturer as indicated on the Drawings.
- C. Control panel shall include the following fully identified by means of permanent nameplates:
 - 1. Control
 - a. Output voltage adjustment.
 - b. Cranking limiter relay.
 - c. Overspeed shutdown.
 - d. Low oil pressure shutdown.
 - e. High coolant temperature shutdown.

- f. Remote Alarm Contacts: Pre-wired SPST contacts to terminal strip for remote indication of all alarm functions.
 - g. Battery operated service light to illuminate panel during power outage conditions.
 - h. Manual-off-auto engine start switch.
 - 2. Visual monitoring
 - a. Frequency Meter: 45-65 Hz range, 3½ inch (89 mm) dial.
 - b. AC Output Voltmeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch (phase-to-phase and phase-to-ground).
 - c. AC Output Ammeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch and 3 current transformers.
 - d. Push-to-test indicator lamps, one for each:
 - 1) Engine run
 - 2) Low oil pressure
 - 3) High water temperature
 - 4) Overspeed and overcrank
 - 5) Overspeed shutdown
 - 6) Failure to crank
 - 7) Failure to establish voltage or frequency.
 - 8) Failure to reach rated voltage at transfer switch in ten (10) seconds
 - e. Engine running time meter.
 - f. Electrical oil pressure gauge.
 - g. Electrical water temperature gauge.
 - h. Mechanical fuel pressure gauge.
 - i. Radiator sight glass.
 - j. DC voltmeter and ammeter.
 - 3. Audible monitoring
 - a. Low oil pressure alarm condition.
 - b. High coolant temperature alarm.
 - c. Failure to crank.
 - d. Failure to establish voltage or frequency.
 - e. Failure to reach rated voltage at transfer switch in ten (10) seconds.
- D. Battery charging system including alternator and solid state regulator.
- E. Remote Annunciator NFPA 110: Provide a remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
Locate annunciator in the Administration Area per owner's instruction.

2.7 WEATHER PROTECTIVE ENCLOSURE

- A. Standard Enclosure:
 - 1. Steel weather protective enclosure with 14 gauge sheet metal and a minimum ambient capability of 43 degrees Celsius (110 degrees Fahrenheit). Shall have removable, and / or hinged doors and removable end panels to allow easy routine maintenance. All hinges and latches shall be rust resistant and doors shall be equipped with rubber seals. A lockable service access cover shall be provided for easy access to the radiator fill cap. The enclosure shall be painted utilizing electrostatically applied powder baked paint.

2.8 AUTOMATIC TRANSFER SWITCHES

- A. Furnish and install automatic transfer switches (ATS) with four (4) poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.
- B. Acceptable Manufacturers:
 - 1. ASCO
 - 2. Russ Electric
 - 3. Zenith
 - 4. Kohler
 - 5. Cummins/Onan
- C. Mechanically Held Transfer Switch
 - 1. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
 - 2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
 - 3. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
 - 4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
 - 5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
 - 6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- D. Microprocessor Controller
 - 1. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
 - 2. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1 percent of nominal voltage. Frequency sensing shall be accurate to ± 0.2 percent. The panel shall be capable of operating over a temperature range of -20 to +60 degrees Celsius and storage from -55 to +85 degrees Celsius.
 - 3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from

the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

4. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
5. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - a. EN 55011:1991 Emission standard - Group 1, Class A
 - b. EN 50082-2:1995 Generic immunity standard, from which:
 - 1) EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
 - 2) ENV 50140:1993 Radiated Electro-Magnetic field immunity
 - 3) EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
 - 4) EN 61000-4-5:1995 Surge transient immunity
 - 5) EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
 - c. IEEE472 (ANSI C37.90A) Ring Wave Test.

E. Enclosure

1. The ATS shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.

F. Controller Display and Keypad

1. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
 - a. Nominal line voltage and frequency
 - b. Single or three phase sensing
 - c. Operating parameter protection
 - d. Transfer operating mode configuration
(Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

G. Voltage, Frequency and Phase Rotation Sensing

1. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E,3 ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3 ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

2. Repetitive accuracy of all settings shall be within $\pm 0.5\%$ over an operating temperature range of -20°C to 60°C .
3. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
4. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
5. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

H. Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
2. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
5. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
 - a. Prior to transfer only.
 - b. Prior to and after transfer.
 - c. Normal to emergency only.
 - d. Emergency to normal only.
 - e. Normal to emergency and emergency to normal.
 - f. All transfer conditions or only when both sources are available.

I. Additional Features

1. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
2. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
3. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
4. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

5. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
 - a. The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
 - 1) Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
 - 2) Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
 - 3) An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.
- J. Engine Exerciser: The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
 1. Enable or disable the routine.
 2. Enable or disable transfer of the load during routine.
 3. Set the start time,
 - time of day
 - day of week
 - week of month (1st, 2nd, 3rd, 4th, alternate or every)
 4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- K. Withstand and Close-On Ratings
 1. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
 2. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
- L. Tests and Certification
 1. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

M. Service Representation

1. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide all work required for a complete system, including complete system testing and checkout. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

3.2 EMERGENCY DISTRIBUTION SYSTEM

- A. All boxes, and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system. Emergency circuits shall be specially marked and shall be run in raceway separate from normal powered circuits. All distribution equipment shall be specifically indicated "EMERGENCY" on the equipment nametag. Color code for emergency markings and all nametags shall be RED.

3.3 COMMISSIONING SERVICE

- A. A final inspection and an initial startup of the system shall be rendered by the authorized factory representatives.
- B. A letter of certification written by the authorized factory representatives, which states that the system is properly installed and does properly function as recommended by the factory and as described in this specification, shall be submitted to the Architect for his approval.
- C. A test run shall be performed by the authorized factory representative in the presence of the Owner, Architect and Engineer; the time of this test run shall be mutually agreed upon by all persons concerned. This test run may, but is not required to, coincide with other testing requirements described in this section.

3.4 INSTALLATION

- A. General: Provide all labor required for a complete installation.
- B. Mounting: Anchor on a four (4) inch concrete pad with bolts and elasto-rib vibration isolators. Pad shall extend a minimum of 18 inches from each side of the generator set skid.

3.5 CONSUMABLES

- A. Refuel during testing as required. After all tests have been performed, fuel tanks shall be filled before system is accepted by Owner. Check oil, coolant, batteries, filters and other consumables. Top off and replace as necessary to leave engine-generator set at full capacity for all consumables.

3.6 TESTING

- A. Factory Testing: The engine generator shall be tested at the factory, demonstrating its performance at full rated load. A certified copy of the test report shall accompany the unit to the field and shall be made available to the building official and copied to the Architect and Engineer.
- B. Field Testing: Conduct tests of the system as required by NEC Article 700 in the presence of the Owner, Architect, Engineer, and Code Authority having jurisdiction. The engine generator set shall demonstrate the actual sequencing of all load onto the generation unit and shall carry the building emergency loads, including any elevator(s), for a minimum period of two (2) hours. Contractor shall insure that all emergency loads are operational before scheduling this test. Test times shall be mutually agreed upon by all persons concerned.

3.7 SYSTEM GROUNDING

- A. The emergency power system generator output shall be grounded as a separately derived system according to the requirements of the Section titled GROUNDING. Bond the generator neutral to the generator ground.

3.8 SIGNS

- A. Refer to Section 16075, Electrical Identification for Sign Requirements.
- B. Service Entrance: A sign shall be placed at the normal power service entrance indicating location of the emergency power engine-generator set.
- C. Generator: Provide a sign arranged to be prominent and legible at the set control panel. Sign shall be an OSHA orange WARNING sign plus text. Sign text shall be "Warning - This equipment starts automatically. Disconnect all sources of supply and load before servicing", or similar approved text.
- D. Fuel Tank: Provide a "Caution - No Smoking" sign on the housing. Sign shall be an OSHA yellow caution sign with text and graphic no-smoking symbol. Provide sign per NFPA 110 Sect. 5.9.7 at both generator gas shut-off valve and building gas shut-off valve to indicate that there is another valve.

3.9 REMOTE WIRING

- A. General: Provide raceway, wiring and control cables from generator control panel to remote points. Underground conduits may be direct buried without concrete encasement if a red plastic warning tape is installed above each conduit.
- B. Remote Points:
 - 1. Engine-Generator Remote Panel
 - 2. Automatic Transfer Switches
 - 3. Automatic Battery Charger. Provide dc wiring from remote charger to battery rack at engine-generator set. Size wire for maximum 2 percent dc voltage drop at full load.
 - 4. Generator control power 120V branch circuit.
 - 5. Engine water jacket heater branch circuit.
 - 6. Outdoor generator housing: battery rack warming jacket 120V branch circuit.
 - 7. Outdoor generator housing: generator strip heater 120V branch circuit. One circuit may serve both jacket heater and generator heater if total load including voltage drop is less than 80% circuit ampacity.

8. Elevator Controllers; (Signals shall be taken from ATS).
9. Building Automation System (BAS); (BAS wires to the ATS).
10. Building Security System
11. Emergency Lighting Automatic Transfer Switches

3.10 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

- A. Provide automatic slave transfer switches where indicated on the drawings for transfer of dimmer branch circuits utilized for emergency lighting.

END OF SECTION 26 32 13

SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPDs) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Section 16400 – Surge Protection Devices, individually mounted and switchboard mounted. Switchboards: Surge Protection Device integrated in switchboards.

1.3 REFERENCES

- A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,
- B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,
- C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- D. National Electrical Code: Article 285
- E. UL 1283 - Electromagnetic Interference Filters
- F. UL 1449, Third Edition, effective September 29, 2009 – Surge Protection Devices

1.4 SUBMITTALS

- A. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.
- B. Submittals shall include UL 1449 3rd Edition Listing documentation verifiable by visiting www.UL.com, clicking "Certifications" link, searching using UL Category Code: VZCA and VZCA2:
 - 1. Short Circuit Current Rating (SCCR)
 - 2. Voltage Protection Ratings (VPRs) for all modes
 - 3. Maximum Continuous Operating Voltage rating (MCOV)
 - 4. I-nominal rating (I-n)
 - 5. SPD shall be UL listed and labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications.
- C. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.

- D. Minimum of ten (10) year warranty Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

1.5 QUALITY ASSURANCE

- A. List individual units under UL 1449 (Third Addition) and UL 1283.
- B. Single manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. SPD shall comply with NEC Article 285 and shall be permanently marked with the short-circuit current rating of the device.
- D. Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.
- E. Manufacturer shall be ISO 9001 or 9002 certified.
- F. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- G. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept equipment on site in factory packaging. Inspect for damage.
- B. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.
- C. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICES (SPDs)

- A. Manufacturers:
 - 1. Current Technology
 - 2. Liebert
 - 3. Siemens
 - 4. Square D
 - 5. GE

- B. Product Description: Surge protection devices for protection of AC electrical circuits.
- C. Unit Operating Voltage: As indicated on Drawings.
- D. Construction:
1. Finish: Factory finish of baked enamel.
 2. Balanced Suppression Platform: Equally distribute surge current to Metal Oxide Varistor (MOV) components to ensure equal stressing and maximum performance. Furnish surge suppression platform with equal impedance paths to each matched MOV.
 3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.
 4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:
 - a. Continuous monitoring of fusing system.
 - b. Monitor individual MOV's (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.
 - c. Monitor for overheating in each mode due to thermal runaway.
 - d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.
 5. Labeling: Permanently affix UL 1449 (Third Addition) suppression voltage ratings and CSA to unit.
- E. Types:
1. Switchboards; locate as integral part of switchboard, coordinate mounting with switchboard manufacturer.
 2. Panelboards; locate as stand-alone. Component in housing adjacent to protected panelboard.
- F. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).
- G. Switchboards:
1. The SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.
 2. SPD shall meet or exceed the following criteria:
 - a. Maximum 7-Mode surge current capability shall be 300kA per phase.
 - b. UL 1449 - Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

	MCOV				
VOLTAGE	L-N	L-G	N-G	L-L	
208Y/120	800V	800V	800V	1200V	150V
480Y/277	1200V	1200V	1200V	2000V	320V

3. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V

- | | | | |
|--|----------|-----|------|
| | 480Y/347 | 15% | 320V |
|--|----------|-----|------|
4. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of -50dB at 100 kHz.
 5. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
 6. SPD shall include a serviceable, replaceable module.
 7. SPD shall be equipped with the following diagnostics:
 - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 - d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after installation.

8. SPD shall have a response time no greater than 1/2 nanosecond.
9. SPD shall have a 10 year warranty.

H. Distribution and Lighting Panelboards:

1. Listing requirements: SPD shall bear the UL Mark and shall be Listed to most recent editions of UL 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
2. Listing requirements: SPD and performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters without posting at UL.com shall not be approved. (To access UL Category Code click on Certifications in the left menu bar of UL's home page. Type "VZCA" into the Category Code search box and click Search.)
3. SPD shall be UL 1449 labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
4. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
5. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
6. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems
7. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's.
8. SPD shall meet or exceed the following criteria:
9. Minimum surge current capability (single pulse rated) per phase shall be:
 - a. Distribution applications:
 - 1) Siemens Model TPS3 09 with Maximum surge current capability of 100kA per phase

10. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G
208Y/120V	700V	700V	700V
480Y/277V	1500V	1500V	1500V

UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277V	20%	320V

11. SPD shall include a serviceable, replaceable module (excluding Distribution).
(Deletable note: Delete or adjust as appropriate.)
12. Service Entrance SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
13. SPD shall have a warranty for a period of ten (10) years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.
14. SPDs shall be equipped with the following diagnostics:
- a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 - d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify mounting area is ready for equipment.
- B. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

- A. Install in accordance with IEEE 1100.
- B. Install service entrance suppressors in switchboard.
- C. Install suppressors for panelboards adjacent to panel.

- D. Install surge counter in face of switchboard.
- E. Include surge counter for stand-alone SPD.
- F. Install with maximum conductor length of 24 inches. Install suppressor with internal fusing.
- G. Provide 30 amp, 3 pole circuit breaker in panelboards to feed SPD.

END OF SECTION 26 43 00

SECTION 26 50 00 - LIGHTING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaires complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.
- B. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.
- C. Specification Review: A complete item by item, line by line specification review.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Provide luminaires listed by U.L.
 - 2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
 - 3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.
- B. Certification: Certify that fixtures submittal have trim compatible with ceilings being installed.
- C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.5 EXTRA MATERIALS

- A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.
- B. Provide ten (10) percent spare lamps of each lamp type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Acceptable Manufacture: Provide per Fixture Schedule on drawings.
 - 1. Approved equal: Contractor may submit luminaires from other manufacturers. Contractor shall provide a full set of submittals per paragraph 1.2 of this specification section for Engineer and Architects approval. Contractor must have approved submittals stamped and dated from the Engineer and Architect minimum 10 days prior to bid.
- B. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.
- C. All luminaires shall be new and of specification grade.
- D. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.
- E. Wire guard at fixtures in mechanical, electrical, and high abuse areas.

2.2 FLUORESCENT LUMINAIRES

- A. Provide fluorescent fixtures complete with lamp ballast.
 - 1. Housing: Fabricated using 22 gage steel minimum. Housing shall have complete coverage of white paint, 85 percent minimum reflectivity applied by light or powder process, then baked until cured.
- B. Fluorescent fixture lenses where required, shall be light-stable 100 percent virgin acrylic, translucent conforming to minimum standards of IES-NEMP-SPI. Lens shall be pattern 12 prismatic unless noted otherwise. Thickness of material shall be nominal 0.125 inches. The lens shall be formed with a minimum of eight (8) ounces of acrylic per square foot.
- C. Parabolic fixtures shall have both ballast housing reflector covers installed including fixtures requiring only a single ballast. Static Luminaires: All luminaires shall be static type with no-air-handling functions. Punchouts closed with dampers or AIA-Pattern control blades are unacceptable.
- D. Reflectors for compact fluorescent lamps (CFL):
 - 1. All reflectors of each type to be from single manufacturer.
 - 2. CFL reflectors shall have low iridescence.
 - 3. Reflector Color: Semi-specular natural aluminum.

2.3 LED LUMINAIRES

- A. Quality Assurance
 - 1. DOE Lighting Facts certified.
- B. LED Specifications

1. Lumen maintenance of the LEDs has been tested in accordance with IESNA LM-80-08 reporting methodology.
 2. CRI: >82 minimum (general); >90 healthcare and retail.
 3. SDCM: <2.5 in linear pendants and linear recessed; <3.5 in discrete recessed.
 4. R9: .0 (general office/school environments); >50 in healthcare and retail environments.
 5. Outdoor luminaires to be rated at a minimum of 40° C.
- C. Lumen Maintenance
1. Minimum L70 at 50K hours based on TM-21 Addendum A Lifetime report at an ambient temperature of 25° C, outdoors at an ambient temperature of 40° C.
- D. Thermal Testing
1. ISTM testing in accordance to UL 1598-2008.
- E. Driver
1. 0-10V enabled.
 2. Output Class 2 rated.
 3. Dimming range: 5-100%.
 4. Constant current.
 5. THD @ max load: <20%.
 6. Power factor: >0.95
 7. Environment protection rating: UL Damp and dry.
 8. Approbations: certified to UL8750, UL1310, UL935, CSA-C22.2 No. 250.13-12, CSA 22.2 No. 223.
 9. ROHS Compliant
- F. Fixture photometry
1. Conducted by a NVLAP accredited testing lab with IESNA LM 79-08.
 2. System flux measured in delivered lumens.
- G. Warranty
1. 5 year total system warranty.

2.4 COMPACT FLUORESCENT LAMP BALLAST

- A. Manufacturers:
1. CFL ballast shall be furnished by luminaire manufacturer.
 2. Manufacturers:
 - a. Advance Transformer
 - b. ESI
 - c. Lightolier
 - d. Motorola
 - e. Magnetek
 3. All CFL ballast shall be solid state electronic type.
- B. Efficiency: All ballast shall comply with Public Law 100-357; "National Appliance Energy Conservation Amendments of 1988". Ballast shall be marked with symbol "E-inside-a-circle".

- C. Standard: UL Listed, 60 hertz line frequency.
- D. CFL Starting Circuit:
 - 1. CFL lamps 4 pin modified rapid start.
- E. Ballast factor of 0.95 minimum.
- F. Class P thermal protector
- G. Ballast shall have Class A sound rating.
- H. Minimum starting temperature indoors: 50 degrees Fahrenheit.
- I. Total harmonic distortion of 10 percent or less.
- J. Power Factor of 90 percent minimum.
- K. Lamp Shutdown Protection: Ballast shall detect lamp fault and disconnect lamp from circuit per NEMA recommendations for CFL lamp shutoff circuits.
- L. Warranty: five (5) years.
- M. Voltage: Branch circuit voltage connection shall be readily adjustable dual voltage (120/277) ballasts

2.5 SOLID STATE ELECTRONIC BALLAST

- A. Manufacturers:
 - 1. Advance Transformer Standard Series.
 - 2. Universal Lighting Technologies, Inc.
 - 3. Howard Industries Precision, Inc.
 - 4. Osram Sylvania / Motorola Gold Edition
 - 5. SLI Lighting
- B. Product Description: High Frequency Solid State Electronic Program Start ballast suitable for lamps specified, with voltage to match luminaire voltage.
- C. Lamp Compatibility:
 - 1. Ballast shall be two or three lamp type as required by Luminaire quantity.
 - 2. Ballast shall not reduce the rated life published by the lamp manufacturer.
- D. Voltage: Branch circuit voltage connection shall be readily adjustable dual voltage (120/277) ballasts.
- E. Inrush Current: Submit ballast manufacturer published data for inrush current for each type of electronic ballast required.
- F. Standards:
 - 1. Power Factor: 0.95 minimum for 20 percent THD models and 0.99 for 10 percent THD models.
 - 2. Total harmonic distortion, 20 percent or less.
 - 3. Ballast Warranty: Ballast shall have five (5) year written warranty from date of manufacturer against mechanical or electrical defects under normal conditions of use.

4. CBM Label: Provide fluorescent ballast comply with Certified Ballast Manufacturers Association (CBM) Standards and carry the CBM Mark on the label.
5. Frequency: 60 hertz line frequency.
6. ANSI Ballast Factor: Minimum ballast factor of 0.85.
7. UL Listed and Class P.
8. When located outdoors provide suitable for starting lamps at 0 Degrees F.

2.6 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. All recessed HID fixtures shall be thermally protected at the fixture. Remote ballast shall have thermal protection and line fusing.
- B. All HID ballast shall be High Power Factor type constant wattage.
- C. Ballast Circuit: Shall be magnetic-regulator or auto regulator.
- D. Product Description: ANSI C82.4, metal halide lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.7 FLUORESCENT LAMPS

- A. T8 Fluorescent:
 1. Lamp Color: Provide NEMA color designated RE 741 lamps. Lamp color temperature shall be 4100 Kelvin with CRI of 75 minimum. Lamp shall have rare earth triphosphor coating.
 2. Watts: All lamps shall be reduced wattage energy saving. Provide four(4) foot lamps rated at 32 watts.
 3. Reduced Mercury: four (4) foot T8 lamps shall be reduced mercury type. Lamps shall be Philips Alto Series, Osram Sylvania ECO Series or GE reduced mercury with green caps.

2.8 EMERGENCY BATTERY PACKS

- A. Provide Emergi-Lite FPSIU series, or approved equal, battery pack for fluorescent fixtures designated to have emergency battery back-up.
- B. Fixture shall include lighted push button test switch installed in visible, accessible location adjacent to fixture.
- C. Provide unswitched alternating current power source per manufacturer's instructions.
- D. Provide connection to local switch where indicated on drawings, connect such that fixture can be controlled on/off from local switch without discharge of battery.
- E. For fixtures designated to have emergency battery pack and be on a contactor controlled circuit, provide unswitched alternating current source ahead of contactor and wiring as required to allow automatic on/off control from the contactor without discharge of battery and local on/off switching where indicated.
- F. Battery pack shall provide 1100 lumen output for 90 minutes per 2'x4' light fixture.
- G. Provide integral battery pack for all exit signs where emergency generator power is not available. Battery pack shall provide minimum of 90 minutes output.

2.9 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

- A. Provide automatic transfer switch on all lighting fixtures shown to be on emergency.

2.10 HID LAMPS

- A. All lamps shall be clear unless indicated on the Drawings as phosphor-coated or required to be phosphor-coated by fixture manufacturer for proper photometric performance.
- B. Protect HID Lighting fixtures on the side of the ballast with fuse holder. Size and type of fuse shall be per ballast manufacturer.

2.11 DOWNLIGHT FIXTURES

- A. Provide recessed light fixtures with trim rings compatible with the ceiling material where fixture is to be installed.

2.12 COMPACT FLUORESCENT LAMPS (CFL)

- A. Provide Lamp with NEMA color RE 835. Lamp color temperature of 3500 Kelvin. Lamp color rendering index shall be 82 minimum.
- B. CFL shape shall be triple tube, installed vertical, unless luminaire schedule on Drawings states otherwise. Provide Phillips PL-T Series Amalgam CFL or approved equal.

2.13 ACCEPTABLE LAMP MANUFACTURERS

- A. Manufacturers:
 - 1. General Electric
 - 2. Osram Sylvania
 - 3. Venture Lighting
 - 4. North American Phillips
- B. Products shall be produced by manufacturers shown or as scheduled from each type of lighting fixture.
- C. Furnish all lamps of each type from the same manufacturer.

2.14 EXIT SIGNS

- A. Exit signs shall meet visibility requirements and be listed per UL 924 "Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.
- B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.
- C. Product Description:
 - 1. LED Exit Sign:
 - a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.
- D. Housing: Diecast aluminum with stencil face and matte white paint finish.

- E. Input Voltage: 120/277 volt, dual input voltage.
- F. EPA Energy Star Label.
- G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

2.15 OUTDOOR LUMINAIRE POLE ASSEMBLIES

- A. Outdoor Pole assemblies shall consist of a pole base, pole, luminaire or group and lighting circuit wiring.
- B. Diesel Standard: 2000 (IBC) International Building Code. Section 1609 requires wind forces on structure to be determined by the provisions of ASCE 7.
- C. Minimum Wind Speed: 120 miles per hour.
- D. Metal poles shall comply with NEC 410-15(b).
- E. Pole Material: Steel.
- F. Pole Shape: Round tapered.
- G. Pole finish shall match luminaires along mounting arms and bolt covers. Provide polyester powder coat finish on pole and luminaire, 3 mil thick.
- H. Pole accessories to include handhole and cover, full matching anchor bolt cover, anchor bolt kit, template, washers and leveling nuts.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.
- B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.
- C. Clean and repair existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. General: All luminaires shall have proper supports.
- B. Install suspended luminaires using pendants supported from swivel hangers.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Chain Hung: Unless otherwise indicated all fluorescent fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with

Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.

F. Suspended Ceilings:

1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
3. Luminaires shall be centered in ceiling tile.
4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
5. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.

- G. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. Luminaires weighing more than 30 pounds shall be supported independently of the outlet box.

3.3 LOCATIONS

- A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

- A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

- A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

3.6 LAMPS

- A. Clean all lamps after installation.

3.7 CLEANING

- A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.
- B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.8 OUTDOOR LUMINAIRE POLES

- A. Pole Base: Do not grout space between pole base plate and top of concrete pole foundation. Leave open to allow water to drain and for pole to breathe. If grout is recommended by pole manufacture in space between pole base plate and top of concrete pole foundation, provide grout with drain hole through grouting.
- B. Pole Delivery: Unwrap pole upon delivery to job site, unless otherwise instructed by pole manufacturer. Wrapped poles exposed to weather that show wrapper striping or other deterioration of finish shall be replaced at Contractor expense. Replacement shall be new pole or pole refinished at pole factory.
- C. Installation:
 - 1. Poles shall be erected only with luminaire(s) or equivalent damping device, unless otherwise instructed by pole or luminaire manufacturer. Poles installed without luminaires are subject to increased modes of vibration.
 - 2. Do not level pole with shims; leveling nuts above and below pole baseplate provide flexible adjustment and long-term holding of pole position.
 - 3. Provide anchor bolts and pole manufacturer's bolt template prior to concrete formwork for pole bases.
 - 4. Minimum wire size for circuit tap inside pole shall be AWG #12.
 - 5. Install pole base cover. Cover shall rest on top of concrete pole foundation and completely conceal air space under pole base plate.
- D. Fusing:
 - 1. Install fuse holder and fuses as noted in pole base detail on Drawings.
 - 2. All ballast-controlled luminaires shall be protected by Bussmann Fuses FNQ with Holders HEB (1-pole) or (2-pole) HEX. Fuse(s) and holder shall be mounted inside pole at handhole. Size of fuse to be recommended by the luminaire manufacturer.

3.9 RFI

- A. Provide flexible braided metal electrical bonding strap from grounded housing to door frame of all fluorescent parabolic fixtures in designated rooms. Bonding strap shall be braided conductor designed for field installation to either long door side.

END OF SECTION 26 50 00

SECTION 26 55 61 – BROADCAST LIGHTING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Supply of all broadcast lighting devices, equipment and components as required for a complete and operational system. Setup of all loose equipment (e.g. lighting control console, video monitors, printers, etc.) is by this Contractor.
- B. Provision and installation of all conduit, wire, back boxes, junction boxes, pull boxes and terminal boxes as required by the drawings and specifications is by the Electrical Contractor. Installation of all equipment, devices and permanently installed equipment is by the Electrical Contractor. Provision and installation of All 120vac and control wire and terminations shall be by the Electrical Contractor.
- C. Configure lighting control network, including programming of managed switch as required to maximize transmission rate for devices transmitting data at different rates.
- D. Programming of control console shall be provided by a Factory certified technician. Programming will include having a lighting board operator on site to establish "broadcast lighting looks" and save them to the console and preset stations. Programming shall be as defined by the Theater Consultant and the Owner.
- E. Field verification of dimensions, conditions and obstructions at the job site.
- F. Submissions of shop drawings for all components, equipment, materials, systems and interconnection of the same.
- G. Coordination of manufacturing and installation of all systems supplied herein. Field inspection and supervision of installation work provided by the Electrical Contractor.
- H. System inspection, turn-on, commissioning and final adjustment.
- I. Delivery, assembly, installation, focusing as required of all broadcast lighting fixtures. Work shall be conducted by individuals trained and skilled in Broadcast Lighting hanging and focusing. For the TV Broadcast Studio fixtures the contractor will install, focus, assign DMX addresses and program the colorsource lighting control console.
- K. Owner training as outlined by these specifications.
- L. Systems operations and maintenance manuals.
- M. System warranty as defined by these specifications.
- N. The lighting system shall basically be comprised of the following:
 - 1. Broadcast lighting relay panel and control systems
 - 2. Broadcast lighting circuit distribution systems.
 - 3. Broadcast lighting fixtures including installation, focusing and programming.

1.3 QUALITY ASSURANCE

- A. Work shall be done by people skilled in this trade in strict accordance with the requirements and/or specification of the manufacturers of the material being used.
- B. Qualifications:
 - 1. The lighting systems integrator shall be a Factory approved and warranted service center for all of the equipment supplied. Field engineers and service technicians shall be factory

trained and qualified for all on-site and in-shop engineering services required. The Systems Integrator shall be a dealer of all manufacturers of the proposed equipment. Integrator must be a warranted service center for all of the equipment supplied. The manufacturer shall have been engaged in the production of entertainment and theatrical lighting and control systems for a minimum of ten (10) years.

2. The manufacturer shall have completed a minimum of ten (10) system installations of similar or larger size.
3. The manufacturer shall be capable of providing a factory trained field engineer to the job site within 24 hours of a service call. They shall maintain a 24 hour emergency service phone line. A call to the emergency line shall result in an engineer responding within 30 minutes from the time of call.
4. Field engineers and service technicians shall be factory trained and qualified for all on-site and in-shop engineering services required.
5. Specified Broadcast Lighting Manufacturers: (Systems are based on products manufactured by ETC, however Strand Lighting is an approved manufacturer).
 - a. ETC
3030 Laura Lane
Middleton, WI 53562
(608) 831-4116
 - b. SSRC
2172-A River Road
Greer, SC 29650
(864) 848-9770
 - c. Union Connector
300 Babylon Turnpike
Roosevelt, NY 11575
(516) 623-7461
 - d. Pathway Connectivity
480C 36 Avenue SE
Calgary ABT25 W4
(403) 243-8110
 - e. Middle Atlantic Products Inc.
North Corporate Drive
Riverdale, NJ 07457
(973) 839-8821
 - f. Desisti
DESMAR CORPORATION
1011, Route 22 East – Unit “D” – Mountainside, NJ 07092
(908) 317-0020
6. The Lighting Systems shall be provided by one of the following pre-approved Lighting System Integrators:
 - a. Texas Scenic, San Antonio, TX (210) 684-0091
 - b. Vincent Lighting Systems, Pittsburgh, PA (412) 788-5250
 - c. Barbizon Lighting, New York, NY (212) 586-1620

1.4 REFERENCES

- A. Regulatory Agencies:
 1. Electronics Industries Association

2. National Electrical Code
3. National Electrical Manufacturers Association
4. National Fire Protection Association
5. Underwriter's Laboratories
6. Occupational Safety and Health Act of 1970
7. Additional applicable codes, standards, regulations and guidelines shall be adhered to in both spirit and letter of intent.

1.5 SUBMITTALS

A. Shop Drawings

1. Submit field coordinated shop drawings for approval prior to installation. Shop drawings shall indicate all box locations, mounting heights, pull box and junction box locations, conduit routing and conduit wire fill. Site dimensions and conditions affecting the Work shall be verified prior to commencement of Shop Drawings.
2. Shop drawings shall be wholly coordinated with other work of the Electrical Contractor.
3. Shop drawings shall be made in conformity with the best modern practice and all design shall reflect a requirement for minimizing institutional maintenance.
4. Submit electronic shop drawings. All drawings shall be produced on AutoCAD or compatible system to ensure legibility and quality of submission. Obtain approval of the drawings prior to proceeding with manufacture and fabrication. Complete shop drawings shall include:
 - a. General arrangement plans and diagrams indicating location of each device, component and equipment item. (1/4" = 1'-0" minimum)
 - b. Component installation details. (1" = 1'-0" minimum)
 - c. Manufacturer's component equipment drawings
 - d. Manufacturer's catalogs cuts showing weight, dimensions and capacities of mechanical components.
 - e. Power and control riser diagrams indicating wire and cable routing for all lighting devices.

B. As-Builts:

1. Submit in accordance with the General Conditions.
2. Four copies of as-built and installed shop drawings. AutoCAD copies of general arrangement, elevations and connection details shall be provided on disk as part of the As-built drawing submission.

1.6 WARRANTY, SERVICE AND TRAINING

- A. The Contractor shall warrant systems to be free of defective components, faulty workmanship or improper installation/adjustment for a period of one (1) year from the date of Owner's final acceptance.
- B. The field supervisor and project manager for this Contractor shall be present at the Systems turn-on, checkout and testing and Owner training session. The Contractor shall make necessary repairs and advise on field installation nuances at time of training. Failure to attend these meetings may result in delay of final approval of overall system.
- C. Programming of the systems with the Theater Consultant and the Owner's representatives shall include control console setup and channel assignments (including assignment for interface with the house lighting systems), definition of preset / entry station functions and programming of the

various presets (including house lights and various broadcast lighting “looks”), and assignment/setup of all lighting network locations and Gateways as required. Programming session requires a qualified lighting board operator to be on site and operating the console throughout the session. Modifications to the program assignments may be made as part of other training sessions

- D. Training shall consist of (2) two-hour sessions at times mutually agreeable to the Owner and this Contractor. The training session shall occur no later than (7) days after final inspection and approval of the system. Training shall include programming of the control systems as directed by the user group and theater consultant.
- E. This Contractor shall provide one half-yearly visit to the site for checking and adjusting of equipment. The visit shall occur six months after the system has been accepted and shall be at a time mutually agreeable to the Owner and this Contractor. Visit can coincide with training session if mutually agreeable with Owner.
- F. For the first (30) days after final acceptance of the system, the Contractor shall be required to answer all service calls within twenty-four hours of a request being made. After the (30) day period, the Contractor shall meet all requirements established by the one (1) year warranty.

1.7 SUBSTITUTIONS

- A. Requests for substitutions and/or alternate manufacturers for the specified equipment, components and/or accessories shall be made in writing prior to bid. Requests shall provide detailed description of the substituted item, effect the substitution will have on the overall system, benefits of substitution over the specified product and any cost advantages to the substitution. Requests for substitution shall be made minimum (14) days prior to bid. Review of proposed substitution by the Consultant, Architect or Owner shall not be construed as acceptance of the substitution.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Where equipment, components or wiring systems have been omitted from the specifications or drawings, but are necessary for the operation of the system, they shall be provided by this Contractor without claim for additional payment or time.
- B. Where the specified control cables differ from the Manufacturer’s recommended cable and are required for a fully operational system, it shall be the responsibility of this Contractor to bring this discrepancy to the attention of the Architect and Consultant prior to bid.
- C. Items, materials and equipment shall be new and undamaged. Uniform materials shall be used throughout. All steelwork shall be cleaned, primed with rust inhibitor and painted with epoxy resin or baked enamel finish. This Contractor shall replace or repair all damaged equipment. All touch-up paint shall match the manufacturer’s color identically.
- D. The mechanical fabrication and workmanship shall incorporate best practices for good fit and finish. There shall not be any burrs or sharp edges to cause a hazard to operating personnel.

2.2 EQUIPMENT

- A. Major Equipment List: Theater Space

ITEM	MFGR	MODEL	QUANTITY
24 Cct. Relay Panel	ETC	Sensor IQ-24-MCB22k + 120-24S Door	1
DMX Opto-splitter	ETC	RSN-OPTO-Dbox 16 w/Din Enclosure	1
Control Console	ETC	Colorsound 20	1
25’ Power Cable	ETC	Colorsound 20	1
25’ DMX Cable	Proplex	5 Pin XLR	1

Console Dust Cover	ETC	Colorsources 20	1
Circuit Distribution Boxes	ETC	Pipe and Surface Mtd. Boxes	Lot
Control Receptacles	ETC	Pipe and Surface Mtd. Boxes	Lot

2.3 BROADCAST LIGHTING – 120vac DISTRIBUTION EQUIPMENT

- A. This system shall include all 120vac wiring devices for the connection of portable broadcast lighting fixtures. Devices shall be provided as defined by the drawings. Devices shall be constructed of black aluminum in thickness required by structural and NEC requirements.
- B. Provision and installation of all broadcast lighting electrical devices as defined by the device schedules and drawings shall be the responsibility of the Electrical Contractor. All materials must comply with the NEC. All electrical equipment and materials shall have the listing of the Underwriter's Laboratories, Inc. and shall bear the labels attesting to UL listing.
- C. All devices shall be provided with provided prewired with 125 degree XLP high temperature wire to molded barrier terminal blocks. Terminal blocks shall be sized to accept #10 THHN conductors.
- D. All devices shall be appropriately labeled with permanently attached lamacoid circuit numbers. Where custom panels are specified they shall be silk screened or finished as defined by the drawings.
- E. Where components, support devices and other materials have been omitted from the specifications and drawings, but are necessary for the operation of the system, they shall be provided without additional cost to the Owner.

2.4 BROADCAST LIGHTING FIXTURES AND ACCESSORIES

- A. TV BROADCAST STUDIO - Provide the following fixtures and accessories: (See Drawings for more information and accessories)

6 – Desisti Super LED 4.7 Fresnels (tungsten balanced) (DMX controlled) with Powercon Connector, C-Clamp and Four Leaf Barndoors.

6 – ETC ColorSource Junior PAR Deep Blue-Black (CSPARJRDB). With soft focus diffuser, pattern holder & PowerCON connector. Apollo Get-A-Grip Black. Install with Selador Flood Lens, but provide N, M, & EX-W Round Diffusers in Frame –Black.

8 – ETC Colorsources Junior Spots Deep Blue Zoom 25-50 Ellipsoidal Spotlights (CSSPOTJRDB2550) with Powercon connector.

6 – Desisti Soft LED Studio Lights with c-clamp, gel frame, Powercon Connector

20 – 5' Edison to Powercon Adaptors

16 – 5' 5-Pin XLR Extension Cables (DMX)

16 – 10' 5-Pin XLR Extension Cables (DMX)

16 – 5' powerCON Male to powerCON Female Jumper

16 – 10' powerCON Male to powerCON Female Jumper

8 - Altman - 99-DMX Terminator

4 – Matthews Baby Jr. Double Riser Castered Stands Model 386025

8 – Matthews 15# Sand Bag Model 299559

PART 3 – EXECUTION

3.1 PREPARATION

- A. Examine all Work prepared by others to receive Work of this Section and report defects affecting installation to the Consultant. Commencement of Work shall be construed as complete acceptance of preparatory Work. The sphere of inspection shall include but not be limited to:
 - 1. Coordination of device locations with other trades and Work provided by others.
 - 2. Coordination of all box sizes and conduit routing.
 - 3. Assurance all mounting surfaces are ready to accept the Work.
 - 4. Verification of flatness, plumb and level of mounting conditions.
 - 5. Inspection of all components of the Work supplied by others to insure no damage has occurred during shipping or storage.
- B. Examine the site and review the contract drawings to become familiar with the work. Field verify all dimensions at the site prior to installation and advise the Consultant of all system modifications required by field conditions.
- C. Coordinate the Work with related trades. This shall include the preparation of schedules and coordination of equipment delivery and storage.
- D. Appropriate signage shall be furnished during overhead Work to caution of personnel working above.
- E. All broadcast lighting fixtures shall be delivered to the job site, assembled, lamped, installed, circuited, gelled and focused as directed by the owner, theater consultant and the lighting plot. Provide all labor and materials as required to accomplish this work.

3.2 WORKMANSHIP

- A. The installation of all Work shall be neat. All equipment shall be plumb and square. All cables shall be neatly bundled with plastic tie wraps as required.
- B. Surface mounted devices shall be provided with an integral backbox/enclosure by this Contractor. The enclosure shall be designed such that the receptacle faceplate does not overhang the edges of the enclosure. In all surface mounted cases, the faceplates and back box enclosure shall be flush along the outside edges and provided by this Contractor.
- C. Work that is damaged or improperly installed will be removed and replaced. Materials and labor required for such repairs shall be provided without claim for payment.
- D. Terminations shall be accomplished with appropriate connectors. Provide strain-relief at connectors where required.

3.3 INSPECTION AND TESTING

- A. The Consultant following receipt in writing or notification from this Contractor that the installation is completed shall make final inspection.
- B. If inspection reveals any detail of construction, fabrication, or installation not in strict accord with the specification and contract requirements, approval shall be withheld and the Contractor shall be given thirty days to repair the rejected items as required. In addition to the final inspection of components the Consultant shall have the right of inspection during the course of the installation, and shall be allowed access to materials at the side for eventual incorporation in the Work. Preliminary inspection shall not be construed as eliminating the possible rejection of various components during the final inspection detailed above.
- C. The completed installation of the system shall be tested and operated for the approval of the Consultant.
- D. This Contractor's field supervisor and project manager must be on site during the system turn on, check-out and testing and Owner training.
- E. The following condition must be met before final approval can be granted:

1. Final tests and inspections are approved.
2. Punch list items complete.
3. Submittal of three copies of warranty.
4. Submittal of record drawings and instruction manuals.
5. Owner training completed.

END OF SECTION 26 55 61

SECTION 27 00 00 - BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 RELATED WORK

- A. The entire drawing and specification package apply to the work specified in the telecommunications sections of the specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.02 SCOPE OF WORK

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.
- C. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- D. Provide line-by-line specification review for each Division 27 section annotated to certify compliance or deviation.

1.03 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for review. No departures shall be made without prior written acceptance of the Engineer.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings.
- D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.04 CODES AND STANDARDS

- A. All work shall comply with the applicable articles of the National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by National Fire Protection Association), and City Codes and Ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities.
- B. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
- C. ANSI/TIA:
 - 1. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 - 2. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
 - 3. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
 - 4. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - 5. ANSI/TIA-568.0-D (September 2015) Generic B (supersedes TIA-568-C.0 and TIA-568-C-1)
 - 6. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)ANSI/TIA-568.2-D (September 2018) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 - 7. ANSI/TIA-568.3-D (June 2016) Optical Fiber Cabling Components Standard
 - 8. ANSI/TIA-568.4-D (August 2020) Broadband Coaxial Cabling Components Standard
 - 9. ANSI/TIA-569-E (May 2019) Telecommunications Pathways and Spaces
 - 10. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
 - 11. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
 - 12. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
 - 13. ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 - 14. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 - 15. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
 - 16. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers
 - 17. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises
 - 18. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
 - 19. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
 - 20. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency

Capabilities to 2 GHz - Addendum to TIA-1183

21. TIA-1152 (November 2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
22. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard
23. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
24. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
25. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
26. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
27. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard-Type MPO
28. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
29. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
30. TSB-184 (July 2009) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
31. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
32. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths
33. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
34. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
35. TIA-492AAAE (June 2016) Detail Specification for 50- μ m Core Diameter/125- μ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
36. TIA-492AAAB-A (November 2009) Detail specification for 50- μ m core diameter/125- μ m cladding diameter class 1a graded-index multimode optical fibers
37. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis
38. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

D. ISO/IEC:

1. ISO/IEC TR 11801-99-01 Information technology – Generic cabling for customer premises: Guidance for balanced cabling in support of at least 40 GBit/s data transmission: Parts 1 and 2
2. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
3. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centers
4. ISO/IEC 11801 AMD 1 AMD 2 Information technology – Generic cabling for customer premises
5. ISO/IEC 15018 AMD 1 Information technology – Generic cabling for homes
6. ISO/IEC 24702 AMD 1 Information technology – Generic cabling – Industrial premises
7. ISO/IEC 14763-1 AMD 1 Information technology – Implementation and operation of customer premises cabling – Part 1: Administration
8. ISO/IEC 14763-2 Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
9. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within

- administration systems
- 10. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of customer premises cabling -- Part 3: Testing of optical fiber cabling
- 11. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
- 12. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
- 13. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment
- E. BICSI – Building Industry Consultative Services International – Published Standards
 1. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
 2. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
 3. ANSI/BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
 4. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
 5. ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
 6. BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices
 7. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 8. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 9. BICSI – Building Industry Consultative Services International – Manuals
 10. Telecommunications Distribution Methods Manual, 14th Edition (2020)
 11. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 12. Outside Plant Design Reference Manual, 5th Edition
 13. BICSI's ICT Terminology Handbook, Version 1.0
 14. Telecommunications Project Management Manual (TPMM), 1st edition
 15. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
 16. BICSI's Special ICT Design Considerations, Version 1.0
 17. Essentials of Bonding and Grounding, Version 1.0
- F. National Electric Codes
 1. National Electrical Safety Code (NESC) (IEEE C2-2012)
 2. NFPA 70-2020, National Electrical Code® (NEC®)
 3. ANSI/IEEE C2-207, National Electrical Safety Code®
 4. National Electrical Code (NEC) (NFPA 70)
 5. NFPA 72 National Fire Alarm and Signaling Code
- G. ASHRAE
 1. ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings
- H. OSHA Standards and Regulations – all applicable
- I. Local Codes and Standards – all applicable
- J. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

- K. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.
- L. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.
- M. In any instance where these Specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these Specifications shall take precedence. The codes shall govern in case of direct conflict between the Codes and the Drawings.

1.05 EXISTING UTILITIES

- A. The Contract Documents reflect the general location and routing for all telecommunications services known to exist on this project.

1.06 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes and ordinances as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate conduit hangers shall be set before concrete is poured, and proper openings through floors, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters

Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.02 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.03 MANUFACTURER'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper telecommunications equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Engineer in writing of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain from the Engineer instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Engineer.

2.04 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.05 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.06 CONDITION OF MATERIALS

- A. All materials required for the installation of the telecommunications systems shall be new and unused. Any material or equipment damaged in transit from the factory, during delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.07 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with embossed nameplates, securely attached to the equipment with rivets or screws. Nameplates will have information required to specifically identify the equipment in the future such as the

manufacturer's name, address, catalog number, serial number, etc. All data on nameplates shall be legible at the time of final inspection.

PART 3 – EXECUTION

3.01 ACCEPTABLE MANUFACTURERS

- A. The specifications contain the names of manufacturers which are considered acceptable based on the quality of the product.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.
- D. The drawings represent the manufacturer's equipment scheduled. The listing of acceptable manufacturers in the specifications is not intended to imply that equipment of these other manufacturers will fit in the space provided or have the same electrical, structural or other requirements as the equipment scheduled. The Contractor must ensure that the equipment provided will meet all project requirements prior to submitting data on that equipment.

3.02 SPACE AND EQUIPMENT ARRANGEMENT

- A. Equipment and components shall be installed in a manner to permit access to parts requiring service. Telecommunications equipment shall be installed in such a manner as to allow removal for service without disassembly of adjacent equipment.
- B. Large equipment or apparatus which is to be installed in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected from damage.
- C. Equipment shall have working clearances as required by applicable codes and standards.

3.03 SUBMITTAL AND REVIEW OF MATERIALS

- A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. Three weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be considered by the Contractor when scheduling submittal data. After the Contract is awarded, the Contractor will advise the Engineer in writing of the schedule for submission of shop drawings and product data and the persons authorized to sign submittal data on behalf of the Company.
- B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of

the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.

- C. Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing and each item of material or equipment complies with the Contract Documents for this Project. Such certification shall be made by the Owner, a Partner, a Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor. Unless so certified, Shop Drawings and/or Brochures will be returned for resubmittal. Certifications shall be in the form of rubber stamp impressions or typed letter which states:

I hereby certify that this Shop Drawing and/or brochure and the equipment and material shown on this Shop Drawing and/or Brochure complies in all aspects (except as noted*) with the requirements of the Contract Documents for this Project. I further certify that all data shown herein as to performance, dimensions, construction, materials, and other pertinent items are true and correct.

Name of Contractor _____

Signed _____

Position _____

Date _____

*Refer to exception requirements herein.

- D. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:

1. Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least 1/4-inch = 1'-0" scale.
2. All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points, shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be coordinated and clearly shown on the Shop Drawings.
3. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.
4. Brochures submitted shall contain only information which is relevant to the particular

equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.

- E. The submittal format shall follow the Specifications format with a submittal required for each required section. The submittal shall be contained in a three-ring hard back binder. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the Engineer's filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed index sheets also for the Engineer's filing convenience.
- F. Submittal data for each section must be complete. Partial submittals will not be reviewed. To the greatest extent possible all sections shall be submitted with the first submission. No more than three additional submissions will be allowed to complete the submittal package.
- G. Unless a greater number is indicated within Division One of these specifications, submit six (6) copies of all Brochures for review. Submit one (1) reproducible and one (1) blueprint of shop drawings for review. Comments will be made on the reproducible to facilitate copying.
- H. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.
- I. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Owner based on the particular circumstances.

3.04 SUPERVISION

- A. A competent certified foreman or superintendent, approved by the Engineer, shall be maintained at the project site to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Owner or his authorized representative. The Owner and his authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance as required.

3.05 CUTTING AND PATCHING

- A. Where it is necessary to cut through walls, floors, or ceilings to permit installation of work under this section of the Contract, or to repair any defects that may appear, up to the expiration of guarantee period, such cutting shall be done under the supervision of the Engineer. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Engineer.
- B. Patching of all openings and repairing of any damage to the work of other trades occasioned by cutting operations, or occasioned by the failure of any part of work installed under this Contract, shall be performed by the trade whose work is involved, and shall be paid for by

the Contractor.

- C. Openings cut through exterior walls or roofs shall be provided with suitable covers to protect the property or materials involved. Openings cut through walls below grade shall be properly protected to prevent entrance of water or other foreign elements. Openings cut between fire zones or plenums shall be sealed to maintain the fire integrity of the wall or floor. Conduits and cable tray through plenum wall shall be sealed using materials complying with UL 1479, NEC 300-21, and NEC 800-3(C), and shall be UL classified.

3.06 HOISTING, SCAFFOLDING, AND TRANSPORTATION

- A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.07 CLEANING

- A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley adjacent to the site.
- B. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, cabinets, racks and other equipment enclosures. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.08 CONDUIT SLEEVES

- A. Where conduits pass through walls or floors not on fill, galvanized sheet metal sleeves shall be provided and shall be sealed to prevent air and noise transmission. In walls, they shall be flush with each finished surface. In pipe chases, they shall extend 1-1/2 inches above floor slab and be cemented in a water tight manner. Size of these sleeves shall be at least 1/2 inch greater than outside diameter of the conduit.
- B. For conduits passing through outside walls, provide and install galvanized steel sleeves having an inside diameter at least 4 inches greater than the outside diameter of contained conduit. Where these occur in walls having a waterproof coating applied, the sleeves shall have welded flanges to build into waterproofing. When conduits are installed, the annular space between pipe and sleeve shall be effectively sealed, using shredded lead hammered in place or an approved mastic sealer.
- C. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

3.09 GROUNDING

- A. Ground buses shall be provided in each Telecommunications room by Division 16 Contractor unless noted on Contract Drawings.
- B. Telecommunications grounding system shall be a single point grounding from the building entrance electrical ground to each Telecommunications room. This Grounding system shall be provided by Division 16 Contractor unless notes on Contract Drawings.
- C. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels

and/or miscellaneous equipment, etc. shall be grounded by being connected to the common telecommunications grounding system. The conductors shall be a # 6awg solid with a green jacket

3.10 RECEDENCE OF WORK

1. This Contract includes many different systems furnished and installed by different trades. All trades shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping other trades.

3.11 RECORD DRAWINGS

- A. The Contractor shall keep a set of Drawings on the job, noting daily all changes made in these Drawings in connection with the final installation, including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building, and shall turn over a clean, neatly marked set of mylar reproducible Drawings showing "as-installed" work to the Engineer for delivery to the Owner. All underground utilities, services, and systems shall be accurately located by the Contractor and dimensioned on the "as-installed" Drawings.

3.12 OPERATING AND MAINTENANCE MANUAL

- A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each system, piece of equipment, and material installed under this Contract.
- B. Two (2) copies of the manual, bound in hardback binders or an approved equivalent, shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance.
 1. Provide one (1) operation and Maintenance manual for each building. Provide one (1) as-built floor plan and one CD for each building.
- C. The manual shall include the following information
 1. Manufacturer's installation instructions.
 2. Manufacturer's local representative and/or distributor's name and address.
 3. Manufacturer's operating and maintenance instructions.
 4. Manufacturer's internal wiring diagrams.
 5. Contractor's installation wiring diagrams.
 6. Replacement part number listings and descriptions.
 7. Framed operating instructions, when required, in individual Specification sections.
 8. Warranties and guarantees.
 9. Provide an approved submittal at the front of each section.
- D. The manuals shall be identified on the cover as "Operating and Maintenance Manual" with additional cover display of the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.
- E. The manual shall have a Table of Contents and shall be grouped in sections according to the sections of Division 27. Each section shall have a copy of the pages of the Specifications covered within the section. Sections shall be organized as follows:
 1. Each section in the manual shall identify the grouping of all literature required for the

- system or equipment included.
2. The contents of each section shall be arranged in the following sequence: First, the approved engineering submittals with complete performance and technical data; second, the manufacturer's installation brochure; third, the manufacturer's operating and maintenance brochure; fourth, the manufacturer's installation wiring diagram; fifth, the Contractor's field wiring diagram, if different; and sixth, the manufacturer's brochure listing replacement part numbers and description.
 3. Provide a final section entitled, "Warranties and Guarantees", for all equipment, etc.

3.13 EXISTING FACILITIES

1. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, the Contractor shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air condition, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices to protect personnel from injury, removing all such temporary protection upon completion of the work.
2. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
3. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air condition ductwork, and equipment, etc. to provide this access and shall reinstall same upon completion of work.
4. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, the Contractor shall remove and reinstall in locations approved by the Engineer all devices required for the operation of the electrical systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

3.14 DEMOLITION AND RELOCATION

1. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
2. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Engineer. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Engineer and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at not additional cost to the Owner or the Engineer.
3. All items which are to be relocated shall be carefully removed in reverse to original assembly

or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

4. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Engineer.

3.15 OUTAGES

1. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two (2) weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the Contract amount.

END OF SECTION

SECTION 27 05 34 - PATHWAYS AND INFRASTRUCTURE FOR AV SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section describes and specifies infrastructure devices associated with Div. 27 41 15 AV Studio Broadcast Systems.

1.2 DESCRIPTION OF THE WORK

- A. Conduit pathways
- B. Backboxes, Junction Boxes, and Pull Boxes
- C. Cable support devices

1.3 SCOPE OF THE WORK

- A. All Audiovisual Infrastructure devices listed in this Section shall be provided and installed by the Division 26 Electrical Contractor.
- B. Conduit and containment pathways and terminations: Refer to associated AV-series Audiovisual Infrastructure drawings for conduit pathway scope, notes, and requirements.
- C. All enclosures, as listed in the Audiovisual Device Legend sheets in the associated Audiovisual Infrastructure drawing packages, shall be furnished and installed by the Division 26 Electrical Contractor:
 - 1. Specialty enclosures and / or Custom enclosure configurations are listed in this Specification Section.
 - 2. Common enclosures and junction boxes are explicitly called out on Audiovisual Device Legend drawing sheet and are not restated here.
- D. AV Studio Broadcast Systems to be supplied under separate Section (27 41 15 AV Studio Broadcast Systems).

1.4 RELATED DOCUMENTS

- A. The general provisions of the contract, including General Provisions, Supplemental Conditions, and Division 1 – General Requirements, apply to the work specified in this section.
- B. Refer to the associated AV-series Audiovisual Infrastructure drawings for additional information, notes, and exact locations pertaining to Infrastructure devices associated with Audiovisual Systems.

1.5 RELATED SECTIONS

- A. Refer to Division 26 Electrical Drawings and Audiovisual AV-series drawings related to Division 26 electrical for coordination of conduits, pull wires, and connections to electrical power. All conduits, junction boxes, floor boxes and power are by Division 26. Refer to Electrical drawings for all power, and all pathways associated with such power, for Audiovisual systems.
- B. All conduits, junction boxes, and floor boxes associated with Audiovisual System devices shall be provided and installed by the Division 26 Electrical Contractor. Refer to AV-Series Audiovisual drawing sheets for all pathway requirements.

1.6 SUBSTITUTIONS

- A. Refer to Division 1 for specific substitution procedures and submittal requirements.
- B. Many items are listed in the Specifications by the manufacturer's type or model number, without a detailed performance specification, and may not include the phrase "or approved equal". Where this is the case, no substitutions will be accepted, without a written request from the Installer and the written consent of the Consultant and the Owner.
- C. Where the phrase "or approved equal" appears, the item specified shall set a standard of quality and performance, based on the published specifications of the manufacturer and on the actual performance as known by the Consultant.
- D. Requests for substitution, when forwarded by the Installer to the Consultant and Owner, are understood to mean that the Installer represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified, that the same guarantee will be provided for the substitution as for the specified product, and that the Installer will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.
- E. Substitutions will not be considered if they are indicated or implied in Shop Drawing submissions without previous formal request, or, for their implementation, they require a substantial revision of the Contract Documents in order to accommodate their use.
- F. Space allocations and utility rough-ins have been designed on the basis of equipment items named by manufacturer and model number. If any equipment not so named is offered which differs substantially in dimension or configuration from the named equipment, provide scaled shop drawings showing that the substitute can be installed in the space available without interfering with other trades or with access for operation and maintenance in the completed project. The Installer shall coordinate final utility rough-in locations with actual equipment furnished.
- G. Where substitute equipment requiring different arrangement or connections from those shown in the drawings is accepted by the Consultant, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications, making all necessary incidental changes without increasing the Contract amount. Pay all additional costs incurred by adjoining or connecting trades.
- H. All requests for substitutions shall be submitted 2 weeks prior to the bid opening date. Substitutions shall be requested and approved in writing only, based upon these criteria.

1.7 COOPERATION AND COORDINATION

- A. Cooperate and coordinate as required with the other contractors who are responsible for work not included in this section.
- B. Provide any and all information as required or requested by the Owner, Architect/Engineer, Consultant, or General Contractor in order for this work to be completed to the satisfaction of the Owner, and in the best interests of the Project. Such assistance or information shall be transmitted in writing to the requesting party in all cases. All written correspondence shall be copied to the Consultant.

1.8 GUARANTEE AND WARRANTY

- A. Guarantee all parts, labor, and workmanship furnished under this contract for a period of twelve months from the date of substantial completion.

- B. During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 48 hours after request by the Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.
- C. Where warranties on individual pieces of equipment exceed twelve months, the guarantee period shall be extended to the warranty period of the particular items.

1.9 SUBMITTALS

- A. Equipment lists, data sheets, etc. shall be 8-½" x 11" size, properly bound into a single or multiple volumes as necessary, and also submitted in electronic PDF format. Submit quantity in accordance with Division 1, General Requirements.
- B. Within 45 days after the notice to proceed, submit to the Architect/Engineer identical copies of the following for approval:
 - 1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item;
 - 2. Manufacturers' data sheets on all equipment items;
 - 3. Floor plans and reflected ceiling plans, prepared at a scale not less than 1/8" = 1'-0", showing device locations and orientation for all items in scope;
 - 4. Riser diagrams showing conduit requirements, to include all pull boxes and outlet boxes;
 - 5. Proposed construction details for all devices in this Specification Section. These details shall show dimensions, materials, finishes and color selection;

1.10 JOB CONDITIONS

- A. Coordinate installation of mounts, back-boxes, floor boxes and all other devices specified in this Section with work of other trades.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items shall be new and unused. The following articles specifically list the acceptable items for this project. Where quantities are not noted, they may be obtained from the associated drawings. In the event of a discrepancy between the specifications and the drawings, the greater quantity or better quality shall be furnished.

2.2 CABLE SUPPORT DEVICES

- A. Furnish and install cable support devices for use with routing Audiovisual cabling at Audiovisual equipment and production locations as shown.
- B. Secure to wall and/or ceiling structure with appropriate hardware and fasteners, as required by wall and/or ceiling type.
- C. Coordinate with other trades, as required, to eliminate interference and obstructions with other devices.
- D. Coordinate penetrations at walls and partitions, as required. Provide fire-stop intumescent bags or other local / superseding code-approved fire-stop mechanisms at all required penetrations. Multiple fire-stop system shall be employed, as required, to equal the full capacity of the cable tray.
- E. Furnish and install the following:

1. Ladder Rack: Hoffman LSS-18BLK, or approved equal, 1'-0" ladder rack system. Provide support brackets and all manufacturer-required hardware and accessories. (Qty: as required to support pathways shown)
2. Type "J" Cable J-Hooks: nVent Caddy CAT64HPBA 4" J-Hook with retaining clip, black. (Qty: as shown)
3. Type "PT" Cable Pass-Through: Beckson Marine DP40B 4" screw-out deck plate, to include manufacturer's captive chain kit. (Qty: 1 deck plate at each side of wall)

PART 3 - EXECUTION

3.1 INSPECTION

- A. Installer must examine substrates and conditions under which floor and wall mounted hardware and equipment enclosures are to be installed and notify the Consultant and Architect in writing of conditions detrimental to proper and timely completion of work.

3.2 INSTALLATION

- A. Install the cable management trays, floor boxes, specialty enclosures and display wall boxes at the locations shown and in accordance with manufacturer's instructions. Install all devices level, plumb, secure and at the proper height. Cooperate with other trades to secure units to finished wall and floor surfaces. Repair and replace damaged items as directed by the Architect.
- B. Coordinate layout of conduits, including specific routing and mounting elevations, with building structure and work of other trades.
- C. Avoid crossing building expansion joints, to the extent possible. Where crossings occur, use expansion joints.
- D. Provide a pull string in all raceways, cable trays, and conduits. Provide high tensile-strength pull lines in all conduits 4" and larger.
- E. Installation of wall boxes back-to-back in opposite sides of a wall shall not be allowed. Allow a minimum of 2'-0" between boxes. At stud walls, provide a minimum separation of 1 stud cavity.
- F. Provide protection for installed components so that all will be in perfect operating condition, without damage at completion of the project.

3.3 ADJUSTMENT AND CLEANING

- A. Clean exposed surfaces of installed products.
- B. Clean up all debris caused by work of this Section, keeping the premises neat and clean at all times.

END OF SECTION 27 05 34

SECTION 27 10 00 – STRUCTURED CABLING SYSTEM (SCS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- A. 26 05 00 – Grounding and Bonding
- B. 26 05 29 – Electrical Hangers and Supports
- C. 26 05 33 – Raceway and Boxes
- D. All Division 27 and 28

1.3 DESCRIPTION

- A. Summary of Work:
 - 1. Provide a new, complete, and tested Category CAT6A cable distribution system for data interconnections (Local Area Network) in the new campus. The data distribution system shall include fully terminated unshielded twisted pair cables, raceways, conduit, UTP termination devices, data communications outlets, patch panels, patch cables, network racks, and other incidental and miscellaneous premises wiring system hardware as required for a complete and usable system. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.
 - 2. Provide and install building entrance terminals as required.
 - 3. Provide all CommScope POE extender devices and cabling as required to provide fully functional systems as indicated on drawings and herein.

1.4 QUALITY ASSURANCE

- A. Acceptable manufacturers:
 - 1. The equipment/products described herein and furnished per these specifications shall be the product of one manufacturer. All references to model numbers and other detailed descriptive data is intended to establish standards of design performance, and quality, as required
 - 2. The approved manufacturers shall provide a complete Category 6A solution with a 25-year performance warranty.
 - 3. **Acceptable product connectivity and cable shall be Uniprise by CommScope.** Only the manufacturers listed in this paragraph will be accepted.
 - 4. All products shall be Category 6A compliant. NO EXCEPTIONS.
- B. Installer Qualifications:
 - 1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) similar size, Category 6A, projects and contact names confirming successful Category 6A premises wiring system installations.
 - 2. The SCS Installer shall be a certified CommScope Uniprise or Panduit and in good standing in the Partner Program, local area, integrator and must be able to provide the manufacturer's maximum available warranty on the entire SCS. The contractor's certification must have been obtained and held within 75 miles of the project's location.

3. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
 4. All individuals installing the SCS must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
 5. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing SCS contractor will be allowed for any portion of the SCS scope of work.
- C. Pre-Construction Meeting:
1. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant and individuals deemed necessary by the Owner's representative prior to the start of the work. No SCS work shall begin prior to this meeting.
- D. Acceptance:
1. The Owner's representative reserves the right to reject all, or a portion of the work performed, either on technical or aesthetic grounds.
- E. Warranty:
1. The selected system installer shall be a CommScope Uniprise or Panduit, certified contractor and hold current certification. The contractor shall provide an end-to-end performance warranty of not less than twenty (25) years on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL Category 6A cable links have been tested bi-directionally (end to end) using a Level 2 tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-C and/or TSB-67 Link values.
 2. The warranty will also cover multimode fiber optic cabling. Performance testing shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, method B.
 3. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.

1.5 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
1. Latest Local Codes and Amendments
 2. 2014 National Electrical Code
- B. Other References:
1. TIA/EIA-568-C Commercial Building Telecommunications Wiring Standard
 2. EIA/TIA-569 Commercial Building Standard for Telecommunication Pathways and Spaces.
 3. TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
 4. TIA/EIA-607 Commercial Building Grounding

5. and Bonding Requirements for Telecommunications.
EIA/TIA 455-A Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
 6. TIA/EIA TSB 67 Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 7. TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines
 8. ISO/IEC 11801 Generic Cabling Standard
 9. EN 50173 Generic Cabling Standards for Customer Premises
 10. ANSI/EIA/TIA 526-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.
- C. Governing Codes and Conflicts: If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.6 ABBREVIATIONS

- A. The following abbreviations are used in this document:
- | | |
|-----|---------------------------------|
| DC | Direct Current |
| IDF | Intermediate Distribution Frame |
| MDF | Main Distribution Frame |
| PBX | Private Branch Exchange |
| UTP | Unshielded Twisted Pair |

1.7 SUBMITTALS

- A. Project Initiation:
1. Within fourteen (14) days of Notice to Proceed, the data network system installer shall furnish the following in a single consolidated submittal:
 - a. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer.
 - b. Product Literature: Complete manufacturer's product literature for all cable, patch panels, cross-connect blocks, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Designer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included. The submittal shall have some type of distinguishing marker or pointer to indicated what specific product is to be provided
 - c. Construction Schedule: A time-scaled Construction Schedule, using PERT/CPM, indicating general project deadlines and specific dates relating to the installation of the cable distribution system.
 - d. Testing: Proposed Contractor Category 6A UTP cable test result forms, fiber optic cable test result forms and a list of instrumentation to be used for systems testing.
 - e. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the

specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

- f. Certifications: The contractor shall submit all of the following certifications and the certifications must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.

- 1) BICSI RCDD Certification: This certification must be held by an on-staff, full-time employee of the SCS installer. The holder must be staffed out of the office that is located within 75 miles of the projected.
- 2) Proposed Manufacturer's Strategic Partner Certification: This certification have been obtained by the SCS installer's office that is located within 75 miles of the project and shall be a company certification, not and individual certification.
- 3) Proposed Manufacturer's Installer Certification: This certification must be held by at least 25% of the, on-site, staff and be made available at the site if requested by the owner, architect, and/or project's technology consultant.
- 4) Fiber Optic Technician Certification: This certification must be held by the on-staff/on-site individual that is supervising the fiber optic installation and performing the fiber optic terminations and testing.

B. Shop Drawings:

1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Proposed circuit routing and circuit grouping plan prepared by a BICSI certified RCDD (Registered Communications Distribution Designer). The RCDD certification must be current. Identifiable, separate routing shall be shown for both the station cabling and the MDF-to-IDF tie cabling.
 - b. In addition to the cable routing, the submitted drawings shall indicate the following, even if the following is expected to be provided by the project's electrical or general contractor:
 - 1) Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 2) Location of sleeved wall pass-thru
 - 3) Size of sleeve at each location installed
 - 4) Quantity of cable passing through each sleeve
 - 5) Location of drops in each room (quantity or labeling of drops are not required in the submittal plans. Labeling shall be provided in the closeout plans and quantities shall be as per the contract documents, addendums, and issued changes. Each drop shall be labeled for the type of outlet that it is)
 - 6) Conduit routing, size, quantity, and stub-up locations for all floor mounted outlets.
 - c. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

C. Close-out Procedures:

1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 - b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document.
 - c. Include the Name, address, and telephone of the authorized factory representative with a 24-hour emergency service number.
 - d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed, a list of recommended spare parts.
 - e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - f. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 - g. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2019 or later. Provide the Owner with electronic versions of the As-Built on (2) 8GB thumb drives.
 - h. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 - i. A copy of the manufacturer's warranty on the installed system.
 - j. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 - k. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
 - l. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours.
 - m. One (1) 30" x 42" laminated floor plan sheets illustrating technology drops and cable designation. Contractor shall provide one complete floor plan sheet for each telecommunications room (MDF or IDF)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Installation: The cabling shall be installed per requirements of the manufacturer and the Project Documents utilizing materials meeting all applicable TIA/EIA standards. The Contractor is responsible for providing all incidental and/or miscellaneous hardware not

explicitly specified below as required for a complete and operational system.

- B. Materials: Materials shall be as listed or shall be approved equivalent products of other manufacturers meeting the intent and quality level of the TIA/EIA specifications. All approved equivalent products will be published by addendum ten days prior to proposal for Architect/Engineer to review.
- C. Testing: All installed cabling shall be tested 100% good after installation by the Contractor. All final test results shall be delivered to owner at completion of project. Refer to closeout requirements listed under section 1.5.
- D. Ratings: All products shall be new and brought to the job site in the original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label. All communications cable shall bear flammability testing ratings as follows:
 - CM Communications Cable
 - CMP Plenum Rated Communications Cable
 - CMR Riser-Rated Communications Cable
- E. Initial Cable Inspection: The Contractor shall inspect all cable prior to installation to verify that it is identified properly on the reel identification label, that it is of the proper gauge, containing the correct number of pairs, etc. Note any buckling of the jacket that would indicate possible problems. Damaged cable or any other components failing to meet specifications shall not be used in the installation.
- F. Cable Lubricants: Lubricants specifically designed for installing communications cable may be used to reduce pulling tension as necessary when pulling cable into conduit.
 - 1. Approved Products
 - a. Twisted-pair cable: Dyna-Blue
American Polywater
- G. Fire Wall Sealant: Any penetration through firewalls (including those in sleeves) will be resealed with an Underwriter Laboratories (UL) approved sealant.
 - 1. Approved Products
 - a. 3M or
 - b. Pre-approved equal

2.2 DATA CLOSET (MDF/IDF) CATEGORY 6A TERMINATION HARDWARE AS SHOWN ON DRAWINGS

A. Equipment Racks/Cabinets:

Provide and install equipment racks and/or cabinets in locations indicated on the attached drawings for the following areas.

For all IDF and MDF locations

Contractor shall provide and install new floor mounted rack systems. Refer to floor plan and enlarged MDF/IDF room layouts for number of racks to provide at each location.

- 1. 2-post Floor mounted racks – CommScope
 - a. 760082479 | RK3-45A
- 2. 4-post Floor mounted racks – CommScope
 - a. 760082560 | RK4P45-36A
- 3. Wall Mounted network cabinet – Chatsworth Products
 - a. 11996-X48 - CUBE-iT Wall-Mount Cabinet
 - b. Provide the following accessories as required

- i. 40972-001 - Standard Fan and Filter Kit
- ii. 40970-7## - Vertical Cabling Section for CUBE-iT Wall-Mount
- iii. 40971-X48 - Vertical Lashing Bracket
- iv. 25190-000 - Cable Port Brush Kit
- v. 11837-701 - Horizontal Wire Management Bar
- vi. 12787-548 - Equipment Mounting Rail Kit
- vii. 40974-X19 - Rack-Mount Shelf
- viii. 40159-009 - Ground Jumpers
- ix. 12820-706 - Power Strip

B. Distribution Rack/Cabinet Grounding

All Racks and/or Cabinets shall be grounded using stranded #6 AWG insulated copper conductor. Connect to service entrance grounding electrode. Provide all required bonding materials and hardware and bond to building grounding electrode subsystem at building electrical service entrance.

1. Grounding Compression Lugs
 - a. 245529-10
2. Wall Mount Bus Bar (one per MDF/IDF location)
 - a. UGBKIT-0210

C. Category 6A Patch Panels – CommScope

The Category 6A data and Wireless Access Point (WAP) station cable shall be terminated on Category 6A RJ45 patch panels with circuit board construction, T568B terminations. Patch panels shall be 19-inch rack mountable. Workstation patch panels shall terminate all workstation communications outlets. Furnish units that adhere to the performance requirements TIA/EIA-568A standards.

1. Approved Products:
 - a. 24 Port Patch Panels- 760162800 | UNP-6A-DM-1U-24
 - b. 48 Port Patch Panels- 760162818 | UNP-6A-DM-2U-48
 - c. Install cable support bars at the back of all patch panels to provide additional support at rear of rack and panels

D. Category 6A Rack Patch Cables – CommScope or Panduit equivalent:

1. Network Rack Patch Cables: Cabling Contractor shall provide district with (1) – Category 6A patch cable for each data drop on entire project. These cables will provide connectivity from the front of the network patch panels to the network equipment provided by district upon move-in. The patch cables are to be terminated properly with RJ-45 connections on each end with the proper pin-out assignments per project configuration.
2. 6' Category 6A Patch Cable
 - 1) UC1AAA2 Series
3. 6' Category 6A Patch Cable Color Scheme:
 - 1) BLUE - Data and VOIP
 - 2) WHITE – Wireless Access Points
 - 3) YELLOW – Security Cameras, Environmental Sensors, Door Access Systems
 - 4) GREEN – PA Systems
 - 5) RED – Fire Alarm
4. Provide the following lengths and percentages of patch cables
 - 1) 10% 12"
 - 2) 30% 3'
 - 3) 30% 5'
 - 4) 30% 7'

E. Cable Management – CommScope or Panduit equivalent

1. Provide cable management panels as required for vertical cable management. Provide vertical wire management on ends and in between all racks on entire project. All vertical cable managers on the entire project shall be black double-sided 10" wide management.
2. Horizontal and Vertical Products
 - a. Vertical
 - i. 760244781 | VCM-DS-84-10B
 - b. Horizontal
 - i. 2U – 760 | HTK-19-DS-2U

2.3 BASKET TRAY AS SHOWN ON DRAWINGS.

- A. Cable tray shall be used to route all cabling in major hallways and corridors. The cable tray shall be a two-tiered system with Fiber on the top and all copper cabling on the bottom. Cable tray shall consist of a minimum 2" deep steel wire mesh tray with all necessary cable dropouts, bend radius protection, connectors and all other components to create a fully functional cable tray system that will not threaten the structural integrity of the cable jacket. All threaded rods supporting the tray will be covered with a plastic sleeve to protect the cable jacket.
- B. Approved manufacturers:
1. Panduit
 2. Owner approved manufacturer.

2.4 LADDER RACKS AS SHOWN ON DRAWINGS.

- A. Ladder Racks shall be used in all MDF/IDF rooms. Ladder Rack shall be 12" wide and 2" deep, minimum. Approved manufacturers:
1. CommScope - 760085647 | CR-SLR-10L12W (black)
 - a. Accessories (black):
 - 1) Cable Runway Elevation Kit (CPI) - #10506-706 – per rack
 - 2) Rack-to-Runway Mounting Plate: 760084053 | CRR2RRMK – per rack
 - 3) Cable Runway Radius Drop: 760083956 | CRDK-12W
 - 4) Ladder Rack 90° Horiz. E-Bend Section: 760085530 | CR90FCB-12W
 - 5) Wall Angle Support Kit: 760084160 | CR12-C24WRSK
 - 6) End Cap Kit: 760084012 | CRPECK
 - 7) Junction Splice Kit: 760084046 | CRTJSK.
 - 8) Other required applicable installation accessories
 - b. Provide Velcro straps for cable dressing in MDF/IDF rooms.

2.5 POLE MOUNTED IP SURVEILLANCE CAMERA FIBER/POE EXTENDERS AS SHOWN ON DRAWINGS.

- A. Provide the following POE extender devices, cabling, connectors and accessories. Quantity as shown on drawings and as required to provide fully functioning systems, to include but not limited to:
1. CommScope Part #: PFU-P-C-O-060-01, PoE Extender, Universal Bracket, Outdoor, 60 Watt, 1-Port.
 2. CommScope Part #: CO11152-01F007, PCOSP-6S-BK-7FT, CAT6, F/UTP, Outdoor Rated Patch Cord, 7ft.
 3. CommScope Part #: FAWLCUC01-AXF006, TeraSPEED® OS2 LC to Unconnectorized, Fiber Pigtail, 0.9 mm Tight Buffer, blue jacket, 6 ft, Spliced onto Powered Fiber Cable, fiber 1

4. CommScope Part #: FAWLCUC01-BXF006, TeraSPEED® OS2 LC to Unconnectorized, Fiber Pigtail, 0.9 mm Tight Buffer, orange jacket, 6 ft, Spliced onto Powered Fiber Cable, fiber 2
5. CommScope Part #: 9701008/00, SFS-SLEEVE, Single Fusion Splice Sleeve, 50 Pack
6. CommScope Part #: PFC-S04O12F, Powered Fiber Cable, OS2, 4 Fibers, Outdoor, 12AWG Conductor
7. Transition Networks Part #: TN-GLC-LX-SM-RGD, 1000BASE-LX SFP, 1000BASE-LX and 1G Fiber Channel (1GFC) 10km Industrial Temperature Gen 3 SFP Optical Transceiver, one installed at each access point and network switch port.
8. CommScope Part #: 760251045, EPX-2U-PNL-ENC, Standard Density 2U sliding Panel, accepts (6) LGX/1000 style splice cassettes, modules or panels, 2U shelf accepts 6 cassettes, modules, or panels
9. CommScope Part #: 760221747, PNL-CS-12LCW-PT, TeraSPEED® Splicing cassette, 12LC, 900µm, 1 Splice cassette accommodated 6 duplex ports (pt- with pigtails)
10. CommScope Part #: FEWLCLC42-JXF006, TeraSPEED® OS2 LC to LC, Fiber Patch Cord, 1.6 mm Duplex, Riser, yellow jacket, 6 ft, Patch cord connects fiber shelf to network switch for each device pair.
11. CommScope Part #: PFP-PX-S2, Power Express Starter Shelf Kit, 1 PE shelf accommodates 2 PE modules (16 total output channels)
12. CommScope Part #: PFP-PX-8M, Power Express 8 port Module, 1 PE module supports 8 x 48VDC output channels
13. CommScope Part #: PFP-PX-SF, Power Express Slot Filler, used when less than 2 modules installed in PE shelf
14. CommScope Part #: PFP-SPS-C1, Rectifier Controller with Display, 1 Controller installed in Rectifier Shelf
15. CommScope Part #: PFP-SPS-1600M, 1 Rectifier Module supplies 1200W to distribution shelf.

2.6 CABLE ROUTING/PATHWAY

- A. Cable Support System: All low voltage cabling shall be installed and supported using a modular cable support system at 48" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
- B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.
- C. The innerduct shall be bright orange and shall be labeled fiber optic cables from fiber patch panel to conduit or plenum entrances. Innerduct installed in plenum rated ceilings shall be plenum rated.
 1. Approved products
 - a. Carlon
 - b. Dura-line

2.7 STATION WIRING

- A. Wire: The data and voice wire provided for all outlets shall be (Category 6A) Plenum-Rated unshielded twisted pair, four-pair, 24 AWG solid copper conductor, meeting the intent and quality level of the TIA/EIA-568-A Commercial Building Wiring Standard. Refer to floor plan and data outlet legend for number of active data ports to specified faceplates.
 1. Approved Products: For all voice and data connections: CommScope CS44P or Panduit equivalent
- B. Testing: The Category 6A four-pair UTP cable must be UL Performance Level tested. Each 1000-foot spool must be individually tested with test results affixed to the spool. All cable must be provided on new 1000-foot spools. NO "SHORTS" WILL BE ALLOWED. IF SHORTS ARE DISCOVERED, THE CONTRACTOR WILL BE REQUIRED TO

UNINSTALL ALL CABLE ON THE ENTIRE PROJECT AND INSTALL NEW CABLE AT NO ADDITIONAL COST TO THE OWNER.

- C. Rating: Cable installed in conduit shall be non-plenum rated. Cable not installed in conduit shall be plenum rated if installed in plenum ceiling space, non plenum rated otherwise.
- D. Provide 10 feet service loop at all headend locations properly supported above ceiling. Provide 3' service loop at each workstation outlet properly supported above ceiling. All workstation service loops shall be made in figure eight configurations, no exceptions.
- E. All cable shall be bundled with Velcro from patch panel to outlet. Velcro shall be rated for plenum space.

2.8 STATION HARDWARE

- A. Flush Mount Jacks: Flush mount jacks shall be high quality Category 6A RJ45 modular jacks with circuit board construction and IDC style or 110-style wire, T568B terminations. Jacks shall meet EIA/TIA TSB40 recommendations for Category 6A connecting hardware.
 - 1. Approved Products – Data and Voice Jacks: UNJ10G
 - 2. All blank inserts shall be Gray.
- B. Faceplates: Faceplates shall be a 4-port, flush mounted white CommScope Uniprise solution or Panduit equivalent, for RJ45 outlets at all locations.
Approved Products:
 - 1. 4-Port Single Gang Stainless Steel, CommScope 760072207 | M14SP-L
 - 2. Provide wall mounted handset faceplates where applicable for wall mounted phones. Refer to floor plan for locations. CommScope # 760100891 | M10WL4SP
 - 3. Provide Mounting Straps (where applicable)
- C. Workstation Patch Cables: Cabling Contractor shall provide district with (1) – 10 Foot Category 6A patch cable for each data drop on entire project. Each cable will be terminated properly with RJ45 connections on each end with appropriate pin-out assignments per project configuration. Follow Color Code established in 2.2 D 3
 - 1. Approved Products: CommScope Uniprise or Panduit equivalent, 10 Foot Cat 6A Patch Cable - UC1AAA2

2.9 INDOOR/OUTDOOR PLENUM COPPER CABLE

- A. For those locations where short runs of copper cable from building to building or within a “wet environment” (in slab) will be needed provide the following cables
- B. Indoor/Outdoor Category 6A U/UTP, Plenum, Outdoor Rated, Black Jacket, 4 Pair Count
 - 1. 874036404/10 | CS44P-IO BLK

2.10 Backbone Fiber Optic Cable

- A. All Fiber Optic Cable shall be UL listed OFNP (unless otherwise noted):
- B. Multimode fibers, each with a color-coded PVC tight buffer shall have a maximum attenuation of 1.0dB/km at 1310 nm and 1.0 dB/km at 1550 nm.
- C. No splices will be allowed at any point in the fiber optic runs.
- D. 6-Strand or 12-Strand multimode, OM4, with plenum rated armored jacket shall connect

each IDF with the MDF as specified on technology riser plans.

1. 760128181 | P-006-DZ-5K-FSUAQ
 2. 760128017 | P-012-DZ-5K-FSUAQ
- D. 6-Strand or 12-strand singlemode, with an indoor/outdoor plenum rated jacket, with no metallic elements, shall connect each IDF (that is not connected to the main buildings) with the MDF as specified on the technology riser plans.
1. 760140640 | P-006-LZ-8W-F06BK/25D
 2. 760140475 | P-012-LZ-8W-F12BK/25D

2.11 Fiber Optic Patch Panels

- A. The enclosures used shall provide termination panels for LC type connectors and be of sufficient size and capacity to terminate 110% of the fiber count of the inside of outside fiber optic cables.
- B. Patch Panels must be 19" rack mountable.
- C. Provide all termination accessories, fiber patch cords, enclosures and test for a complete fiber optic distribution system.
1. CommScope 2U fiber shelf #760251047 | EPX-2U-PNL-ENC-FX
 2. CommScope 12 Fiber Inserts LC multimode #760067157 | PNL-BK-012-MFA-LC02-BG-SHUTTERED
 3. CommScope 12 Fiber Inserts LC Single mode #760067165 | PNL-BK-012-SFA-LC02-BL-SHUTTERED
 4. CommScope Wall-Mounted Single Sided Single Door Fiber Enclosure #760248905 | WB2-EMT-BK-2P-PNL

2.12 Fiber Connectors

- A. Optical Fiber Connectors shall be LC type connectors to match fiber type.
1. CommScope LC Multimode #760117887 | MFC-LCF-09-5X Qwik II LC
 2. CommScope LC Single-Mode #760117895 | SFC-LCF-09-8X Qwik II LC

2.13 Fiber Patch Cords

- A. Provide (4) CommScope 3-meter patch cords for each backbone fiber installed on the entire project. Coordinate the required connector type, on the equipment end, with the owner prior to procuring the products.

PART 3 - EXECUTION

3.1 GENERAL

- A. Fire Wall Penetrations: The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. The contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Allowable Cable Bend Radius and Pull Tension: In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturer's allowable bend radius and pull tension data for the maximum allowable limits.
- C. Cable Lubricants: After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.
- D. Pull Strings: Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract. Pull test is not to exceed 200 pounds. Data and video cables can be pulled together with pull strings.
- E. Conduit Fill: Conduit fill shall not exceed 40%.
- F. Damage:
 - 1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
 - 2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- G. Clean Up:
All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

3.2 DOCUMENTATION

- A. LABELING STANDARDS OVERVIEW
 - 1. **Verify labeling standards with Owner.**
 - 2. UNIQUENESS: Each piece of equipment and each cable should have a unique identifier to prevent confusion.
 - 3. CONSISTENCY: Labeling schemes should be consistent within each IDF/MDF and should align with the closet's standard methods.
 - 4. LABEL QUALITY: Use a label maker to ensure clarity, and make sure labels are capable of withstanding environmental factors.
- B. LABEL PLACEMENT:
 - 1. General: All network infrastructure components requiring labels should be carefully marked to ensure clear identification of both the origin and destination of drops. When affixing labels, care should be taken to avoid obstructing LEDs, lenses, or any other features critical to the device's functionality or troubleshooting process.
 - 2. Cables: Attach labels to both ends of each cable. Place labels near termination points, making them easily visible and readable.
 - 3. Wall Plates: Distribute labels evenly between the top and bottom wall plate screws and separate entries with commas. Tape labels right below the top screw and right above the bottom screw.
 - a. Two Port Plates: Place the label for the first drop below the top wall plate screw and the label for the last drop in above the bottom wall plate screw.

- b. Four Port Plates: Comma-separate labels for the first two drops, starting with the first drop below the top wall plate screw. Do the same for the last two drops, starting with the third drop above the bottom wall plate screw.
 - c. Six Port Plates: Comma-separate labels for the first three drops, starting with the first drop below the top wall plate screw. Do the same for the last three drops, starting with the fourth drop above the bottom wall plate screw.
- C. INFORMATION ON LABELS: Labels should contain enough details to identify the cable's or equipment's origin, destination, and function.
- D. LABEL TYPES: Use self-laminating labels or wrap-around labels. Do not use Flag labels or cable tags.
- E. LABEL DIMENSIONS, FONTS, AND MATERIALS:
 - 1. Wall Plate Labels: Use .35" (9mm) laminated black on white label tape. Use 18-point font size for two and four port plates, and 12-point font size for six port wall plates.
 - 2. Access Point (AP) Labels, Camera Labels, and Ceiling Grid Labels: Use .47" (12mm) laminated black on white label tape with a 24-point font size.
 - 3. Ceiling Biscuit Labels: Use .35" (9mm) laminated black on white label tape with an 18-point font size.
 - 4. Wrap Around Cable Labels: Use either .94" (24mm) or .70" (18mm) black on white label tape. Print labels using the Cable Wrap template to ensure the correct font size.
 - 5. Self-Laminating Cable Labels: Use .94" (24mm) black on white label tape with a 12-point font size.
 - 6. Font Style: Use only serif fonts for all labels to ensure readability.
- F. Ceiling Grid Label placement and Marking: Mark the ceiling grid with an orange sticker to identify the environmental drop location. Place the label next to the sticker on the ceiling grid and on the environmental sensor.
- G. Ceiling Plenum Riser Tubes
 - 1. Label each tube according to its service direction (N for North, S for South, E for East, and W for West).
- H. MDF/IDF Patch Cables
- I. Any patch cables exceeding 2 feet in length should be labeled at the patch panel end to indicate the connected switch and port.
 - 1. Use the format: S_P##
 - 2. Where: S = Switch Label, P = Switch Port, ## = Switch Port Number
 - 3. **Examples: 1.12-2_P23 or 1.7_P07**
- J. Floor Plan
 - 1. A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.
 - 2. Contractor shall label wiring on both ends of cable at workstation and headend locations with machine labels, no exceptions.

3.3 EQUIPMENT RACK CONFIGURATION

- A. Equipment Racks: Equipment racks shall be assembled and mounted in locations shown on the Drawings and as detailed. Each rack shall be securely mounted to the floor and braced to the wall with cable tray in accordance with the manufacturer's instructions and

recommendations. Racks shall be mounted such that the side rails are plumb with vertical cable management panels. Racks to be located such that future expansion can occur without relocating existing racks. Racks shall be grounded in accordance with NEC requirements.

- B. Wire Management Components: Horizontal cable management panels shall be installed directly above and below each patch panel, also 1 per patch panel should be left at site to accommodate the switch gear when they are installed. Vertical cable management panels shall be installed on each side of the rack. In instances where more than one rack is installed in a single location, vertical cable management shall be installed between the racks and on either side.
- C. Cable Placement: Cable installation in the Wiring Closet must conform to the Project Drawings. All cabling shall be routed so as to avoid interference with any other service or system, operation, or maintenance location. Avoid crossing area horizontally just above or below any riser conduit. Lay and dress cables to allow other cables to enter the conduit/riser without difficulty at a later time by maintaining a working distance from these openings.
- D. Cable Routing: Cable shall be routed as close as possible to the ceiling, floor, or corners to ensure that adequate wall or backboard space is available for current and future equipment. All cable runs within the Wiring Closet shall be horizontal or vertical within the constraints of minimum cable bending radii. Minimum bend radius shall be observed. Cables shall not be tie-wrapped to electrical conduit or other equipment.
- E. Installation: All incoming cables shall be routed on the cable tray and neatly dressed down to the patch panels.
- F. Hardware: Provide rack and jack panel hardware as required for all data station wiring.

3.4 STATION WIRING INSTALLATION

- A. General:
 - 1. Cabling between wiring closet and workstation locations shall be made as individual home runs. No intermediate punch down blocks or splices may be installed or utilized between the wiring closet and the communications outlet at the workstation location.
 - 2. All cable must be handled with care during installation so as not to change performance specifications. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable. There shall never be more than one and one-half inches of unsheathed enhanced Category 6A UTP cable at either the wiring closet or the workstation termination locations.
- B. Exposed Cable:
 - 1. All cabling shall be installed inside walls or ceiling spaces whenever possible. Exposed station cable will only be run where indicated on the Drawings.
 - 2. Additional exposed cable runs will require Owner approval and will only be allowed when no other options exist.
- C. Placement: All cabling and associated hardware shall be placed so as to make efficient use of available space. All cabling and associated hardware shall be placed so as not to impair the Owner's efficient use of their full capacity.
- D. Cable Routes:
 - 1. All cabling placed in ceiling areas must be in conduit, cable tray or J-Hooks. Cable support shall be permanently anchored to building structure or substrates. Provide

attachment hardware and anchors designed for the structure to which attached and that are suitably sized to carry the weight of the cables to be supported. Do not route cable through webbing of structural steel. Cabling must be supported in dedicated supports intended to support cabling as described in this section.

2. Attaching cables to pipes or other mechanical items is not permitted. Use J-Hooks for up to 15 cables (Chatsworth hooks with appropriate brackets). All runs of sixteen (16) or more cables, provide cable rings on 36-inch maximum centers to hang cable. Communications cable shall be rerouted so as to provide a minimum of 18 inches spacing from light fixtures, sources of heat, power feeder conduits and EMI sources. Cabling shall not be attached to ceiling grid support wires. Cable runs shall be parallel or perpendicular to building structure. Multiple cables to be bundled together every 6 feet.

3.5 STATION HARDWARE

- A. Flush Mount Jacks: Flush mount jacks shall be mounted in a faceplate with backbox.
- B. Placement: Where possible, the communications outlet shall be located so that its centerline is 18 inches above floor level or 12 inches above permanent bench surfaces. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches.
- C. RJ-45 Jack Pin Assignments:
 1. Pin connections for data station cable outlets and patch panels shall match EIA/TIA 568 modular jack wiring recommendation T568B.
 2. Pin connections at data jack panels shall match pin connections at outlets (straight through wiring).

3.6 CABLE TESTING REQUIREMENTS

- A. Notification: The Owner and Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Inspection: Before requesting a final inspection, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and timetable for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.
- D. Errors: When errors are found, the source of each shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Re-test results must be provided on Owner approved forms and witnessed by Owner.
- E. Twisted Pair Cable Testing:
 1. At a minimum, the Contractor shall test all station drop cable pairs from Data Closet termination patch panels to outlet device RJ45 jacks. Category 6A products shall be tested for compliance to ANSI/TIA/EIA 568A and ISO/IES 11801 for a Category 6A rated installation. Test equipment used shall meet TIA/EIA TSB-67, Level II accuracy. Further, the contractor shall have a copy of TSB-67 in their possession and be familiar with its contents.
 2. Each wire/pair shall be tested at both ends for the following:
 - a. Wire map (pin to pin connectivity)

- b. Length (in feet)
- c. Attenuation
- d. Near end cross talk (NEXT)
- e. Power Sum
- 3. Test equipment shall provide an electronic and printed record of these tests.
- 4. Test results for each Category 6A four-pair UTP cable must be submitted with identification to match labels on all patch panel ports and RJ45 jacks and must match as-builts associated with that cable.

3.7 INSPECTION

- A. Conformance to the installation practices covered above are to be verified when completed. In some cases, the Owner/Designer may inspect before acceptance.
 - 1. Written Test Report:
 - a. Complete test results, including actual values associated with tests.
 - b. Show all certifications for telecommunications wiring systems.
 - c. Include cable maps showing each cable route and keyed to cable labels. Provide owner with complete floor plans identifying outlet location and cable routing drawing in AutoCad format. Provide electronic copy of drawings to owner in AutoCad version 14 or greater.
 - d. Documentation of outlet, cable, and rack labeling system.
- B. After performing all tests, tabulate results and bind together in format acceptable to Owner. Installer shall provide written certification in the test report that telecommunications cable is properly installed and test results certify system to all specified standards.

END OF SECTION 27 10 00

SECTION 27 41 15 – AV STUDIO BROADCAST SYSTEMS

PART 1 - GENERAL

1.1 DIVISION OF SCOPE

- A. This section includes AV Studio Broadcast System requirements for components within the following areas:
 - 1. Control Booth
 - 2. Green Room
 - 3. Associated support spaces as explicitly identified in the accompanying AV drawing package.
- B. Reference Audio-Visual drawings as follows:
 - 1. 'AV' Sheets: Associated AV Systems Drawings as part of this bid package.

1.2 RELATED DOCUMENTS:

- A. General Conditions and Requirements, Special Provisions, and applicable portions of Division I of the general contract are hereby made a part of this section.
- B. Architectural, structural, mechanical, electrical, and other applicable documents are considered a part of the Audiovisual System documents insofar as they apply as if referred to in full.

1.3 DESCRIPTION OF THE WORK:

- A. A complete new broadcast production system, to include, but not limited to, the following items:
 - 1. Coordination of AV Systems needs with the electrical systems installation contractor currently working under the Owner.
 - 2. Coordination of AV Systems needs with the Owner's technology department with respect to the IT/datacomm systems and Classroom AV systems.
 - 3. Wiring, as needed, to provide a complete and working audiovisual system, as specified in drawings and specifications.
 - 4. Equipment racks for audiovisual systems
 - 5. Furniture and production consoles for audiovisual systems
 - 6. Audiovisual I/O plates, intercom plates, patch bays, and monitor plates
 - 7. Audio and Video routing and monitoring system
 - 8. "On-Air" light system
 - 9. Video Production and Control Rooms: installation, configuration, and training for new equipment as follows:
 - a. TV broadcast production system, to include all associated processing, routing, distribution, and conversion components
 - b. Broadcast audio digital mixing console system
 - c. Studio and robotic video cameras
 - d. Wired and Wireless Microphone systems
 - e. Playback and recording devices
 - f. Production intercom and interrupted foldback (IFB) systems
 - g. Control system with touchpanels
 - h. Podcast system

1.4 SCOPE OF THE WORK:

- A. These Specifications, together with the related drawings and the general requirements of the contract with the Owner, comprise the requirements for the Audiovisual System for the project.

- B. Furnish, deliver, erect, install and connect completely all of the material and appliances described herein and in the Drawings, and supply all other incidental material and appliances, tools, transportation, etc., required to make the work complete, and to leave the Audiovisual Systems in first class operating condition, excluding those items listed under Section 1.11, RELATED WORK IN OTHER SECTIONS.
- C. Perform all assembly of equipment, wiring and inter-connection and soldering of wires to jacks, devices, terminals or equipment, using technical employees only, who are experienced in the installation of Audiovisual Systems equipment and its inter-connectivity. Coordinate final utility rough-in locations with actual equipment furnished.
- D. Verify dimensions and conditions at the job site prior to installation, and perform installation in accordance with these Specifications, manufacturers' recommendations and all applicable code requirements.
- E. Verify all existing conditions before ordering equipment. Owner shall not be liable for costs associated with return of equipment.

1.5 QUALITY ASSURANCE:

- A. The intent of these Specifications is to describe and provide for a complete Audiovisual Production System of high professional quality and reliability. Professional performance standards by the Audiovisual Systems Contractor (hereafter referred to as Installer) and the equipment will be required.
- B. In all cases, the Owner and Architect shall determine the acceptability of the work based upon the visits, observations, and reports of the Audiovisual Systems Consultant (hereafter referred to as Consultant).

1.6 CONDITIONS OF THE PROPOSAL

- A. Provide a proposal to the Owner for a turn-key system as described in these specifications and drawings.
- B. Provide line-item pricing on all equipment, along with labor, profit, and overhead.
- C. Provide all ancillary information required by the Owner to be set up as a vendor/contractor.
- D. Provide proposed schedule for completion of work, along with assumptions on after hours and weekend work. The Owner may restrict access to the building during school hours.

1.7 SUBSTITUTIONS:

- A. Many items are listed in the Specifications by the manufacturer's type or model number, without a detailed performance specification, and may not include the phrase "or approved equal".
- B. Where the phrase "or approved equal" appears, the item specified shall set a standard of quality and performance, based on the published specifications of the manufacturer and on the actual performance as known by the Consultant.
- C. Requests for substitution, when forwarded by the Installer to the Consultant, are understood to mean that the Installer represents that he has personally investigated the proposed substitute product and determined that it is equal to or superior in all respects to that specified, that the same guarantee will be provided for the substitution as for the specified product, and that the Installer will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.

- D. Substitutions will be considered on the basis of equal performance, only if requested prior to bid date, in writing. No substitutions will be allowed without prior approval.
- E. Space allocations and utility rough-ins have been designed on the basis of equipment items named by manufacturer and model number. If any equipment not so named is offered which differs substantially in dimension or configuration from the named equipment, provide scaled shop drawings showing that the substitute can be installed in the space available without interfering with other trades or with access for operation and maintenance in the completed project. The Installer shall coordinate final utility rough-in locations with actual equipment furnished.
- F. Where substitute equipment requiring different arrangement or connections from those shown in the drawings is accepted by the Consultant, install the equipment to operate properly and in harmony with the intent of the Drawings and Specifications, making all necessary incidental changes without increasing the Contract amount. Pay all additional costs incurred by adjoining or connecting trades.
- G. All requests for substitutions should be submitted before the bid opening date. Substitutions shall be requested and approved in writing only, based upon these criteria. Substitutions requested after bid date will not be considered unless it is determined by the Consultant and Architect that such consideration is in the best interests of the Project.

1.8 INSTALLER QUALIFICATIONS:

- A. The work performed under this Section shall be performed by an Audiovisual Systems contractor, normally engaged in the business of Audiovisual Systems installation. The prospective contractor shall show proof, as part of the bid that the contractor has been in the Audiovisual Systems installation business for a period of not less than five years and has successfully completed projects of similar size and scope.
- B. Each prospective AV Installer shall provide a comprehensive system portfolio of completed projects of comparable size and scope specific to Studio Production and Broadcast applications for review by the AV Consultant.
- C. Each bidder shall hold a current, valid franchise for the major lines of audiovisual equipment furnished by them under these Specifications.
- D. All work shall be performed by employees of the sound subcontractor, and not by contract employees. Work crew must be supervised by a technician holding CTS-I certification.
- E. All systems engineering and shop drawings shall be performed by a technician holding a CTS-D certification.
- F. The Owner and Architect reserve the right to reject any bids submitted by firms without sufficient experience in projects of similar size and scope

1.9 COOPERATION AND COORDINATION:

- A. Cooperate and coordinate as required with the other contractors who are responsible for work not included in this section.
- B. Provide any and all information as required or requested by the Owner and Consultant, in order for this work to be completed to the satisfaction of the Owner, and in the best interests of the Project. Such assistance or information shall be transmitted in writing to the requesting party in all cases. All written correspondence shall be copied to the Consultant.

1.10 GUARANTEE AND WARRANTY:

- A. Guarantee all parts, labor, and workmanship furnished under this contract for a period of twelve (12) months from the date of final commissioning by the consultant.
- B. During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 48 hours after request by the Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.
- C. Where warranties on individual pieces of equipment exceed twelve months, the guarantee period shall be extended to the warranty period of the particular items.
- D. Furnish a complete and working Audiovisual System. Be of maximum assistance to the Owner during the guarantee period of the system, to the degree that maximum Owner satisfaction is assured.
- E. After completion of the work, the Installer shall submit a Certificate of Warranty, stating commence and expiration dates and conditions of the warranty, for signature of both parties. Incremental warranties for completed portions of the work may be negotiated at the discretion of the Owner, if delays occur beyond the control of the Installer.

1.11 SHOP DRAWINGS AND SUBMITTALS:

- A. Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Electronic files of select drawings will be made available to the Installer from the Consultant. A digital files disclaimer shall be signed and returned by the Installer to the Consultant prior to release of such files. The available drawings shall include only: (1) Legend/Power requirements, (2) Conduit Riser, (3) Floor and Reflected Ceiling Plans, (4) Section Views. Drawings shall be prepared and submitted in electronic format, and as directed by the Architect. Equipment lists, data sheets, etc. shall be 8-1/2" x 11" size, properly bound into a single electronic format file. Submit in accordance with Division 1, General Requirements.
- B. Within 2 weeks after the notice to proceed, submit to the Architect/Owner identical copies of the following for approval:
 - 1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item.
 - 2. Manufacturers' data sheets on all equipment items.
 - 3. Equipment rack layouts showing locations of all rack mounted equipment items.
 - 4. Floor plans and reflected ceiling plans, prepared at a scale of not less than 1/8"=1'-0", showing loudspeaker locations and orientation, wall plates, and all other related device locations.
 - 5. Proposed construction details for any custom fabricated items, including loudspeaker mounting, custom interface panels, patch panels, and wall plates. These details shall show dimensions, materials, finishes and color selection.
 - 6. Coordinate with the Architect / Owner regarding color selection of each equipment item and associated mount / mounting hardware for any, and all, exposed devices. Provide factory color options for review in submittal package. The Installer shall request written confirmation from the Architect / Owner on all such devices prior to ordering. Where the Architect's color selection is not a factory color option, the Installer shall coordinate with the device manufacturer for custom color/paint, where available, and, if not available, coordinate with the General Contractor and other trades for field painting.
 - 7. Comprehensive system schematics, showing detailed connections to all equipment, with wire numbers, terminal block numbers, and color coding, at a size and scale that can be read easily from a plotted half-size set.
 - 8. Riser diagrams showing conduit requirements with pull boxes, outlet boxes, physical

9. cable layouts, part numbers of cable types used, and number of circuits in each conduit
Electrical power requirements for head-end and ancillary equipment. Include diagrams for any remote control of electrical power, in sufficient detail to coordinate with the electrical contractor, showing exact conduit requirements and locations for switched duplex receptacles
10. Graphic User Interface layouts showing displays designed for control system panels.
11. IP Addresses for all equipment connected to the AV Network.
12. Certain other submittals as noted elsewhere in this specification, and as may be required for various equipment items prior to construction, fabrication, or finishing of that item.
13. Submission of the AV Contract Documents / Bid Documents does not constitute a legitimate submittal and will not be accepted.
14. Incomplete or partial submittals will not be reviewed.

1.12 FINAL CLOSEOUT DOCUMENTATION:

- A. All final documentation shall be submitted and approved before final acceptance by the Owner will be granted. Submit the following in accordance with Division 1, General Requirements.
 1. A complete as-installed equipment list, listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item
 2. A complete loose equipment list, with manufacturers' names, model numbers, serial numbers, and quantities of each provided.
 3. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codes. System performance measurements as noted elsewhere in this specification shall be documented. Include diagrams or charts showing final settings of all control knobs in the system (mixers, equalizers, power amplifiers, etc.). Submit copies of software settings of each piece of equipment that is software controlled.
 4. Network configuration and routing settings for all network-connected equipment in scope including, but not limited to, the following:
 - a. Full IP settings and addressing for each device.
 - b. Network switch configurations, to include settings for VLANs, QoS, DiffServ, IGMP, and any other setting required for proper AV-network performance.
 - c. Configuration and routing parameters for any Audio / AV-over-IP protocol, to include Dante, QLAN, AES67, AVB, Milan, or any other standard protocol, variant, or proprietary communication platform.
 5. System performance measurements as noted elsewhere in this specification shall be documented. Include diagrams or charts showing final settings of all control knobs in the system (mixers, equalizers, power amplifiers, etc.). Submit copies of processor data files with software settings of each piece of equipment that is software controlled
 6. Complete equipment rack layouts showing locations of all rack mounted equipment items
 7. Floor plans and reflected ceiling plans, prepared at a scale of not less than 1/8"=1'-0", showing loudspeaker locations and orientation, wall plates, rack locations, and other related device locations
 8. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit
 9. Manufacturer's warranties and operating instructions for each and every equipment item furnished. Include a copy of the certificate of warranty, signed by both parties
 10. Technical Systems Operations Manual, custom-written by the Contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately.
 11. Incomplete submittals will not be reviewed.

1.13 RELATED WORK IN OTHER SECTIONS:

- A. All conduits with pull strings, all electrical pull boxes, and all outlet boxes shall be furnished and installed under the electrical section of Division 26. Conduits shall be run continuously from outlet box to outlet box. Conduit stub-outs are not acceptable except as noted. Coordinate as necessary for proper installation.
- B. All 120VAC power conductors and conduits associated with power circuits to all equipment locations shall be furnished and installed under the electrical section of Division 26. The 120VAC power to the equipment racks shall be terminated inside the racks to Audiovisual Contractor supplied rack mounted outlets.
- C. An insulated THW stranded copper ground wire, sized according to NEC, shall be installed under the electrical section of Division 26 from the equipment racks sheet metal to the primary ground point within the building, and terminated at each end to bare metal using approved connectors and clamps.
- D. All built-in millwork and any grille cloth shall be furnished under other sections.
- E. Electrical circuits shown in the AV system drawings are for reference only in depicting the number of electrical circuits needed for operation of these systems.
- F. Advisory datacomm circuits shown in the AV System drawings associated with the building data network are for reference only in depicting the number of network drop locations needed for operation of these systems.
 - 1. Datacomm circuits associated with the dedicated Audiovisual data network are wholly within the AV Contractor's scope of work, as specified in this Section and shown in the accompanying drawings.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. All items shall be new and unused.
- B. The following sections specifically list the acceptable equipment types and items for this project. Where quantities are not noted, they may be obtained from the drawings. In the event of a discrepancy between the specifications and the drawings, the greater quantity or better quality shall be furnished.
- C. Refer to Section 1.6, SUBSTITUTIONS of this specification.

2.2 INSTALLED WIRE AND CABLE:

- A. All wire and cables shall be new and unused.
- B. Wire not installed in equipment racks, not portable, or not installed in conduit shall be plenum-rated and meet all applicable codes.
- C. Furnish and install the following wire and cable:
 - 1. Voice coil loudspeakers:
 - a. High frequency devices (bi/tri-amped systems only): West Penn 226 14AWG twisted pair.
 - b. Mid frequency devices and speaker monitor circuits (bi/tri-amped systems only): West Penn 227 12AWG twisted pair.
 - c. Low frequency and Full-Range devices: West Penn HA210 10AWG twisted pair.
 - 2. Constant voltage (70.7-volt) loudspeaker cable:
 - a. Runs of less than 200 feet: West Penn 225 stranded 16AWG jacketed twisted

- pair.
 - b. Runs of 200' to 300': West Penn 226 stranded 14AWG jacketed twisted pair.
 - c. Runs of 300' to 500': West Penn 227 stranded 12AWG jacketed twisted pair.
 - d. Runs of 500' or more: West Penn HA210 stranded 10AWG jacketed twisted pair.
3. Audio Cable:
- a. Microphone-level audio cable (installed in conduit, not portable): West Penn Wire 452 stranded 22AWG twisted pair with foil shield.
 - b. Line-level audio cable and all inter-rack audio cable: West Penn Wire 452 stranded 22AWG jacketed twisted pair with foil shield.
 - c. Exterior and below-grade Microphone and Line level cable: West Penn AQ293 stranded 18AWG twisted pair with foil shield.
4. Production Intercom cable (installed in conduit, not portable):
- a. 1-Channel: West Penn 293 stranded 18AWG twisted pair with foil shield.
 - b. 2-Channel: West Penn D440 2-pair stranded 18AWG twisted pair with individual foil shield per pair.
 - c. 4-Channel: West Penn D442 4-pair stranded 18AWG twisted pair with individual foil shield per pair.
 - d. Outdoor Production Intercom Cable (exposed directly to sunlight/weather or installed in conduit below grade): West Penn AQ293 stranded 18AWG twisted pair with foil shield.
5. Wireless microphone and RF Assistive Listening System antenna cable:
- a. For runs less than 50 feet: Belden 9310, 50-ohm RG-58A/U coaxial cable with appropriate connectors.
 - b. For runs that exceed 50 feet: Belden 9914, 50-ohm RG-8A/U type coaxial cable with appropriate connectors.
6. Video Cable:
- a. Digital Video Cable (runs of 1' to 330'): Belden 4794R RG7 Coax Cable, or approved equal
 - b. Digital Video Cable (runs of 330' or more): Belden 7731A RG11 Coax Cable, or approved equal
 - c. Video Sync Cable: Belden 1694A RG-6/U Coax Cable, or approved equal
 - d. HDMI Cable: Extron Pro Series high speed 4K verified 22 AWG cable or approved equal
7. Data cable (copper) for networked Audiovisual systems:
- a. Installed Data cable: Belden 10GX62F Cat6A shield cable or approved equal conforming to project standard.
 - b. Data Patch cables: Belden 10GX F/UTP CMR patch cables, or approved equal conforming to project standard.
 - c. Data Patch Panels: Belden Cat6A Shielded 48-Port flat patch panel. Provide labeling kit for each unit supplied
8. Fiber optic cable for networked Audiovisual systems:
- a. 2-Strand Single Mode: Belden FDSC002R0.
 - b. 4-Strand Single Mode: Belden FDSC004R0.
 - c. 6-Strand Single Mode: Belden FDSC006R0.
 - d. 12-Strand Single Mode: Belden FDSC012R0.
 - e. Fiber optic patch panels: Panduit FRME1U 1-rack unit rackmount fiber enclosure with three (3) fiber adaptor panel slots. For each unit supplied, provide FOSMF Fusion Splice modules and FAP6WBUDLCZ Fiber Adaptor Panels with six (6) singlemode duplex LC connectors, in quantities required to satisfy the schematic diagrams. Provide blank filler plates for unpopulated panel slots.
 - f. Interconnect and Patch Cables at Sound Equipment Racks: Provide dual fiber optic cable assemblies of appropriate wavelength, mode, and connector type for fiber optic patch and inter-rack cabling. All fiber optic connector types associated with Audiovisual systems shall be Duplex LC type, unless noted otherwise.
- D. Other equipment control cables shall be stranded wire, appropriately shielded, of gauge and

number of conductors required by the manufacturer for proper operation of the system or equipment item furnished.

- E. Wire and cable for all other devices shall be supplied in accordance with the recommendations of the device manufacturer and the National Electrical Code.

2.3 JACKS, CONNECTORS, AND WALL PLATES:

- A. All plate-mounted connectors shall be ground-insulated from the plates on which they are mounted.
- B. Floor-mounted jacks, unless noted otherwise, shall be installed in floor boxes. The interior plates shall be anodized black. Nomenclature shall be engraved into the interior plate of each floor box with 1/8" block letters filled with white paint. Coordinate floor box insert connector plates with actual floor boxes provided.
- C. For non-standard custom panels, connectors shall be installed on 1/8" thick black anodized aluminum or brushed stainless steel panels. Nomenclature shall be engraved into the plate with 1/8" block letters filled with contrasting paint color. Coordinate final finish selection with Architect prior to Shop Drawing submittals.
- D. All other jacks shall be installed on standard brushed stainless steel finish plates. Nomenclature shall be engraved into the plate with 1/8" block letters filled with black paint.
- E. All AV signal circuit locations shall be numbered logically and consecutively for each circuit/signal type, starting from one (1).
- F. All plate-mounted jacks at exterior locations shall be provided with captive sealing covers.
- G. Unless otherwise specified, all jacks and connectors for the Audio-Video Systems shall be as follows:
 - 1. Audio connectors:
 - a. Microphone and line-level input jacks (XLR type): Neutrik NC3FD-L-B-1 3-pin female XLR panel-mount jacks with gold-plated contacts.
 - b. Audio output jacks (XLR type): Neutrik NC3MD-L-B-1 3-pin male XLR panel-mount jacks with gold-plated contacts.
 - c. TRS 1/4" jacks: Neutrik NJ3FP6C-B locking TRS jack with gold-plated contacts.
 - d. Production Intercom chassis mounted connectors: Neutrik NC6MSD-L-1 6-pin XLR Male conforming to Switchcraft pin configuration, or approved equal by Switchcraft.
 - e. Female cable-end audio connectors: Neutrik NC3FX-B 3-pin female XLR connectors with gold-plated contacts.
 - f. Male cable-end audio connectors: Neutrik NC3MX-B 3-pin male XLR connectors with gold-plated contacts.
 - 2. Video and RF connectors:
 - a. BNC chassis mounted connector (75-Ohm): Neutrik NBB75DFIX Isolated UHD/4K BNC Bulkhead Jack.
 - b. BNC chassis mounted connector (50-Ohm): Amphenol Connex 112443 BNC Bulkhead Jack.
 - c. BNC cable mounted connector (75-ohm): Canare BCP-D series 12G-SDI 4K/UHD rated crimp cable connectors, model(s) sized for video cable type(s) provided.
 - 3. Loudspeaker connectors:
 - a. Chassis mounted speaker connectors: Neutrik NL4MPXX 4-pole locking jack, or approved equal.
 - b. Cable mounted speaker connectors: Neutrik NL4FXX-W-* 4-pole locking plug, or

- approved equal. * = Provide model variant appropriate for cable O.D. for each assembly.
4. Network Data connectors:
 - a. CAT6A chassis mounted connector: Neutrik NE8FDX-Y6-B CAT6A Shielded Bulkhead Jack, Black with rear IDC terminations.
 - b. CAT6A chassis mounted connector (IP65 Rated): Neutrik NE8FDX-Y6-W CAT6A Shielded Bulkhead Jack, Black with rear IDC terminations, and integrated sealing cover. These devices are associated with any configuration at a non-conditioned or exterior location.
 - c. CAT6A cable connectors: Panduit FP6X88MTG Cat6a straight field term plug, or approved equal.
 5. Fiber optic connectors:
 - a. Fiber optic chassis mounted connector: Neutrik OpticalCON DUO NO2-4FDW-A with duplex LC feedthrough socket and (4) solder contacts. Provide Neutrik SCNO-FDW-A captive sealing cover at each location.
 - b. Field-terminated fiber optic connectors shall not be accepted. Contractor shall fusion splice factory terminated duplex LC pigtails or patch cords of appropriate mode and wavelength to installed fiber optic cabling associated with AV System equipment.
 6. Power Sequencing Remote Low-Voltage connectors:
 - a. Provide connectors for use with remote connections for power sequencing switch sets and standalone sequenced power modules. Connectors shall be in an industry standard form factor with an uncommon pin configuration to alleviate any mis-connection from standard audio, production intercom, or DMX systems.
 - b. Chassis-mount 4-pin XLR male: Neutrik NC4MD-L-B-1 4-pole male receptacle with gold contacts and black metal housing.
 - c. Chassis-mount 4-pin XLR female: Neutrik NC4FD-L-B-1 4-pole female receptacle with gold contacts and black metal housing.
 - d. Cable-mount 4-pin XLR male: Neutrik NC4MX-B 4-pole male cable connector with black metal housing and gold contacts.
 - e. Cable-mount 4-pin XLR female: Neutrik NC4FX-B 4-pole female cable connector with black metal housing and gold contacts.
 7. Power connectors:
 - a. Chassis mounted: Neutrik NAC3MPX-TOP chassis-mounted power inlet connector.
 - b. Portable power cable assembly: 25-foot 12/3 SJO flexible power cable terminated in Neutrik NAC3FX-W-TOP at one end and 15-amp Edison plug (Nema 5-15 male) at the other.
- H. Furnish and install the required number of jacks and connectors as indicated on the drawings.

2.4 EQUIPMENT RACKS AND POWER DISTRIBUTION:

- A. Furnish equipment racks to house equipment as configured in drawings.
- B. Power distribution within racks shall be supplied via Middle Atlantic raceway and rackmount power distribution devices.
- C. Each equipment rack shall include locking front and rear doors, side panels, and top and bottom panels unless otherwise noted.
- D. Equipment rack colors shall be flat black.
- E. Heat-producing components shall be mounted with one RU blank panel installed between units, or as the manufacturer recommends. Fill all other unused portions of rack front sections with

matching blank panels.

- F. Furnish (5) sets of spare keys for each equipment rack.
- G. All mounting screws shall be theft resistant.
- H. Install the required number of units, of sufficient size to accommodate the equipment specified, at the locations indicated in the drawings.
- I. At locations / systems with power sequencing, configure so that power amplifiers and active loudspeakers are the last to turn on in system power-up sequence and first to turn off in power-down sequence.
- J. Label outlets in equipment rack to correspond with the circuit number at the power panel.
- K. Provide wiring ducts, rear rack rails, lace strips, lace bars, cable managers, and brush grommets as necessary to create a clean and neat install in the rear of the equipment racks.
- L. Provide blank panels, vent panels, security covers, and drawers, as shown in drawings.
- M. Provide custom panels, as required, to house all connectors and I/O plates, as well as touchpanels.
- N. Provide Middle Atlantic recessor brackets to appropriate panels to allow front doors to fully close when cables are connected. Adjust front rackrails back into rack so that paging mics, intercom mics, and other protruding items do not keep the door from fully closing.
- O. Furnish and install the following, or approved equal:
 - 1. Type "ER" Equipment Rack:
 - a. Middle Atlantic model WR-44-32 pull-out pivoting equipment rack, to include WRFD-44 Front Door, WR-RR-44 Rear Rack Rail Kit, MW-4QT-FC Fan Top with Integrated Thermostatic Controller, and LT-GN-WL Magnetic Work Light. (Qty: as shown)
 - b. Middle Atlantic BR1 Brush Grommet Panel. (Qty: as required)
 - c. Power:
 - 1) Vertical Power Distribution: Custom Middle Atlantic PDW vertical power strip with integrated surge suppression, part# PDW-113289. (Qty: 1 ea.)
 - 2) Rackmount Power Distribution: Middle Atlantic PDX-920R horizontal rackmount power strips (Qty: as required)
 - 3) UPS: Middle Atlantic UPX-2000R-2 2000VA, 20 Amp UPS. (Qty: 1ea.)

2.5 TECHNICAL FURNITURE SYSTEMS:

- A. Furnish and install custom control room technical furniture systems in configurations shown in drawings.
- B. Final finish material to be determined and approved by Owner. Provide line item pricing for different categories of finish material in the Proposal.
- C. Power distribution within console systems shall be supplied via Middle Atlantic PDT power strips, or equivalent.
- D. Operator's console system to have a video monitor mounting system, power/data management system, locking swing-out lower doors, rack turrets, and black powder coated finish.

- E. Provide LED task lights, custom I/O plates, rack cabinets, and all other accessories called out in drawings.
- F. Provide blank panels, vent panels, security covers, and drawers, as shown in drawings.
- G. Mount equipment as shown in drawings. Provide all necessary mounting hardware and console customization to accommodate specified equipment.
- H. Furnish (5) sets of replacement keys for each lock on the Operator's Console System.
- I. Furnish and install the following, or approved equal:
 - 1. Broadcast Control Desk:
 - a. TBC (Time Base Consoles) custom IntelliTrac Compact Type A, configured as shown in the drawings and consisting of the following: 7 bays with desktop worksurface with counter cutout and drop platform for audio mixing console, side panel pair, 5ea. 4RU angled rack turrets, 3ea. under-counter keyboard/mouse trays, 6ea. single arm monitor mounts, and 5ea. front-accessible convenience power outlets. Contact TBC consoles (631.293.4068) and reference Quote #BAIAU-16839-25 for complete component requirements. (Qty: 1 custom desk system)
 - b. Finish: Standard Finish
 - c. Interior power distribution: Middle Atlantic PDT-Series power strips, with appropriate number, and amperage, of circuits and outlets to support all devices at Broadcast Control Desk. (Qty: as required)

2.6 DIGITAL SIGNAL PROCESSOR

- A. The audio processing shall be in the digital domain following the input source and shall remain until power amplification is required.
- B. All network connections to be coordinated with the Owner's network representatives. The Owner's IT department to set-up static IP addresses in association with the Installer.
- C. Provide all data interconnection cabling as shown.
- D. System programmer shall be QSys Level 2 certified or otherwise advanced manufacturer-certified for programming any respective approved substitute DSP product/system.
- E. Include all licensing for DSP plug-ins and Dante™ routing by software, as required.
- F. The system processor shall provide up to 64 x 64 networked audio channels individually configurable as either Q-LAN or AES67 formatted networked audio. Additionally, the system processor shall include 8 x 8 Software-based Dante network audio channels and is licensable for up to 32 x 32 Software-based Dante capacity. Software-based Dante channels used subtract from the overall 64 x 64 network audio capacity.
- G. The system processor shall support an 8-channel total analog I/O capacity and shall be presented as 8 Flex Channel I/O which shall be software definable as analog inputs or outputs in single channel increments in any combination ratio.
- H. The system processor shall have the following front panel controls and indicators: Unit ID button and Power On blue LED. Device Status, monitoring, and logging shall be provided by a standard web interface. On the rear panel, the system processor shall have two 3-pin RS232 Euro Block Connectors, 8 GPI general purpose control inputs on a 10-pin Euro Block Connector, 8 GPO general purpose control outputs on a 10-pin Euro Block Connector, USB C and B connectors to

support AV bridging with QSC Q-SYS cameras and/or present itself as one or more multi-channel USB audio interfaces. Q-SYS Network: LAN A RJ45 1000 Mbps only, LAN B: RJ45 1000 Mbps only.

- I. The system processor shall operate from a single design, which can be comprised of components, wiring, links, text, and graphics on a single or multiple schematic pages. Designs shall include any of the following DSP function blocks, test and measurement components, control components, and layout components: Acoustic Echo Cancellers, SIP Softphone instances, USB Audio host and device blocks, Audio Players, Audio Streaming components, Crossfaders, Crossovers, Delay components, Auto Gain control elements, Compressors, Gates, Duckers, Expanders, Ambient Noise Compensators, Limiters, Gain blocks, Graphic Equalizers, Parametric Equalizers, FIR Filters, All-Pass Filters, Band-Pass Filters, Band-Stop Filters, High-Pass Filters, Low-Pass Filters, FIR High-Pass filters, FIR Low-Pass Filters, Dual-Shelf Equalizers, Notch Filters, Meters, Matrix Mixers, Gain-Sharing Automatic Mixers, Gated Automatic Mixers, Signal Routers, Public Address Routers, Room Combiners, Signal Presence Meters, Tone Generators, Tone and Noise Generators, Dual Trace FFT Measurement Modules, Real Time Analyzers, Signal Injectors, and Signal Probes.
- J. The system processor shall support custom user control interfaces on either proprietary touch screen controllers, network computers utilizing a control application, iOS devices, or any device with a standard web browser. Custom control interfaces shall be capable of having multiple user-selectable pages with different controls on each. All GUI's shall be submitted to the consultant for approval prior to programming and finalization.
- K. Furnish and install the following as indicated in the accompanying Audiovisual drawings, or approved equal:
 1. Digital Signal Processor (DSP): QSC Q-Sys CORE 8-FLEX. (Qty: as shown)
 2. DSP Input Expanders: QSC Q-Sys QIO-ML4i 4-channel mic/line input expander. To be provided with QIO-RMK rackmount kit, as required to support all devices. (Qty: as shown)
 3. Desktop Touch Control Panels: QSC TSC-70-G3 7" touch control panel, to be supplied with TSC-710T-G3 desktop stand accessory. (Qty: as shown)
 4. Network Switches: Netgear M4300-52G-PoE+ (GSM4352PB) 52-Port switch with 48 1G PoE+ RJ45 ports, 2x 1/10GbE ports (Non-PoE+), 2x SFP/SFP+ ports, 591W PoE+ power budget. (Qty: as shown)
 5. Successful Contractor shall be responsible for programming each software configuration file for each system based on intended functionality shown, or implied, in the drawings.
 - a. Each system shall be programmed so the default operating condition is auto-populated upon system power-up.
 - b. Interface with the presentation and control system at each applicable space and program associated touch control panels for user control of all parameters necessary for successful control and operation of connected devices in each system.
 - c. Include controls at the touch control screen:
 - 1) Source selection between Production Studio live stream and scholastic video feed at TV-B locations indicated in the drawings.
 - 2) Engage / disengage "On-Air" light system.
 - d. Terminate and program fire alarm interface at each system. Each system shall be programmed to mute all program audio upon receipt of contact closure from the addressable fire alarm module, provided by fire alarm vendor, at each system location.
 - e. Contractor shall provide a review copy of the programming file to the Consultant for review at the latest four (4) weeks prior to scheduled commissioning trip.

2.7 LOUDSPEAKERS

- A. The drawings indicate the loudspeaker positions and aiming points for each loudspeaker.

- B. Loudspeakers shall be mounted to the structure, at the positions and angles indicated relative to the aiming points. Suspend each component with commercial rigging hardware, in such a way as to facilitate minor angle adjustments. Safety factor shall be at least 5. Furnish rigging details during submittal process. Secure any loose hardware to prevent vibration and rattling. Orient each speaker at the location and angles indicated in the drawings. Make minor adjustments as required to provide even sound distribution.
- C. Measure and record the impedance of each driver at the amplifier terminals. High frequency drivers shall be measured at 1000Hz; low frequency drivers shall be measured at 250Hz. Include the measurements in the final documentation.
- D. Verify factory color option selection with Owner / Architect prior to product acquisition.
- E. Furnish and install the following assemblies, or approved equal:
 - 1. Type "S1" Control Booth loudspeakers: JBL 306P MkII powered 6" 2-way studio monitor speaker. For each unit supplied, provide K&M US-24167-000-55-BLACK large articulating speaker wall mount. (Qty: 2ea.)
 - 2. Type "S2" wall-mounted loudspeakers: QSC AD-S8T 8" 8Ω / 70V loudspeaker with nominal 105° conical dispersion. For each unit supplied, provide YMS8T yoke mount. (Qty: 2ea.)
 - 3. Control Booth Monitor Speaker Controller: Mackie Big Knob Passive monitor controller with 2 selectable sources, 2 selectable outputs, mono/dim/mute switches, and volume control knob. (Qty: 1ea.)

2.8 AUDIO POWER AMPLIFIERS

- A. Provide power amplifiers for use in amplifying audio signals for distribution to the loudspeakers.
- B. Each power amplifier shall have an analog input connector which is either a screw-type barrier strip or XLR type. Networked amplifiers shall incorporate RJ-45 data jacks for network signal and/or control connectivity. Output connectors shall be either barrier strip or Neutrik Speakon connectors. Other types of connectors shall not be accepted. All power amplifiers shall have detented stepping input level controls. Install the units in the main equipment racks and connect as indicated in the drawings.
- C. Provide (1) one amplifier channel for each loudspeaker home run. Size amplifier based on total power consumption of each home run. Locate amplifiers at sound equipment racks associated with each loudspeaker home run / zone.
- D. Furnish and install the following, or approved equal:
 - 1. 4-channel network amplifiers compatible with specified DSP, 700 watts/ch max. @ 8-Ohms: QSC CX-Q-2K4. (Qty: 1ea.)

2.9 DIGITAL MIXING CONSOLE

- A. Furnish a mixing console for use in processing and routing microphone and line level sources.
- B. The mixing console shall have the I/O specified, and be configured on the Dante network.
- C. Configure the console prior to commissioning and provide configuration file to consultant for review.
- D. Configure all Dante enabled devices, including wireless microphones and audio recorders, on the console.
- E. Configure all routing of signal from console to DSP, via Dante into the Q-SYS platform.

- F. Furnish and install the following at the Auditorium, or approved equal:
1. Digital Mixing Console: 48 input channels, 36 total output busses, 24 in / 16 out local I/O, 24 + 1 master fader configuration, I/O port for audio networking expansion: Allen & Heath SQ6. (Qty: 1ea.)
 2. Dante Expansion Card: Allen & Heath SQ-Dante 64x64 Dante Card. Configure each individual mixing console source, as well as a stereo program mix, to be routed via Dante to the TriCaster system. (Qty: 1ea.)
 3. I/O Rack: 24 analog input, 12 analog output, dSnake digital audio networking, remote head-amp control from specified mixing console: Allen & Heath AR2412. (Qty: 1ea.)

2.10 WIRELESS MICROPHONE SYSTEMS:

- A. A diversity UHF wireless microphone system shall be used in the broadcast systems.
- B. As part of the installer's scope, provide and coordinate the services of a representative from the wireless microphone manufacturer to be onsite to perform frequency scanning and monitoring. Work with the manufacturer's representative to select frequency bands so as to avoid interference. Consult with the manufacturer's representative for final frequency coordination.
- C. The wireless receivers shall be provided with rack-mount kits.
- D. Install and configure the manufacturer's wireless microphone management software on the control room computer and/or an owner-provided computer. Train the owner in the use of the program, including how to scan and find available frequencies.
- E. Furnish and install the following wireless systems and accessories, or approved equal:
1. Shure ULXD4Q Quad-channel digital wireless receiver. (Qty: 1ea.)
 2. Shure ULXD1 Wireless bodypack transmitter. (Qty: 4ea.)
 3. Shure TL48 subminiature lavalier microphone with TA4F connector. Verify with the Owner's representative for factory color selection – Black, Tan, or White. (Qty: 4ea.)
 4. Shure SB900B Lithium-Ion rechargeable batteries. (Qty: 4ea.)
 5. Shure SBRC 8- battery rackmount charging station. (Qty: 1ea.)
 6. Shure SBC-AX 2-battery charging module. (Qty: 2ea.)

2.11 PRODUCTION INTERCOM AND INTERRUPTED FOLDBACK (IFB) SYSTEMS

- A. Provide wired production intercom and IFB systems for use in voice communication for personnel coordination and talent direction during events where indicated in the drawings.
- B. Furnish intercom power supplies in sufficient quantities to accommodate all intercom devices per manufacturer's specifications and recommendations for each system.
- C. Refer to associated Audiovisual drawing package for all device, outlet, and equipment locations.
- D. Furnish and install the following Production Intercom System, or approved equal:
1. Clear-Com MS-702 master intercom station. To be supplied with (1) GM-18 gooseneck microphone. (Qty: 1ea.)
 2. Clear-Com RM-702 2-channel remote station. (Qty: 3ea.)
 3. Clear-Com RS-702 2-channel wired intercom belt pack. (Qty: 4ea.)
 4. Clear-Com YC-36 dual-channel beltpack adaptor "Y" cable. (Qty: 1 ea.)
 5. Clear-Com BP-MOUNT desktop beltpack mounting accessory. This device is associated with the control desk audio position. (Qty: 1 ea.)
 6. Clear-Com CC-300 single muff intercom headset w/ flexible dynamic boom mic. (Qty: 8 ea.)
 7. Whirlwind MK6CC-10 10-foot 6-pin XLR-F to XLR-M intercom cable conforming to SwitchCraft 6-pin configuration. (Qty: 5ea.)

8. Whirlwind MK6CC-25 25-foot 6-pin XLR-F to XLR-M intercom cable conforming to SwitchCraft 6-pin configuration. (Qty: 3ea.)
- E. Furnish and install the following IFB Interrupted Foldback System, or approved equal:
 1. Clear-Com PIC-4744 IFB Router. (Qty: 1ea.)
 2. Clear-Com PS-702 2-channel power supply. (Qty: 1 ea.)
 3. Clear-Com MA-704 Master Control Station. To be provided with CEP-RK Rackmount Kit and (1) GM-18 gooseneck microphone. (Qty: 1ea.)
 4. Clear-Com TR-50 IFB Talent Receiver. For each unit supplied, provide 25-foot balanced XLR cable. (Qty: 4ea.)
 5. Clear-Com CC-010A IFB Earset. Provide 1ea. CC-010-ETUBE replacement ear tube and ear tip for each unit supplied. (Qty: 4ea.)

2.12 ON-AIR WALL SIGNS:

- A. Provide wall indication signs to show when spaces are occupied and in-use during "On-Air" times.
- B. Provide all mounting equipment for a complete and clean installation.
- C. Control of the signs shall be custom rackmount switch panel. Provide controls for: On/Off
- D. Furnish and install the following, or approved equal:
 1. Henry Engineering Superlight LED Tally Light Controller. Provide rackshelf for mounting at equipment rack. (Qty: 3ea.)
 2. Type OA-A On Air Signs: TITUS BPL-RED. (Qty: 2ea.)
 3. Type OA-B On Air Sign: TITUS LPL-HB. (Qty: 1ea.)

2.13 VIDEO PRODUCTION SYSTEM:

- A. Provide a complete TV Broadcast production system, as shown in the drawings, for use with ingest, processing, and switching of video, camera, and character generator sources.
- B. System shall have the following capabilities:
 1. 8 x simultaneous external video inputs, supporting any combination of compatible sources.
 2. 8 x IP video inputs via NDI
 3. 4 x HD/SD-SDI video inputs
 4. 2 x HD/SD-SDI video outputs
 5. 4 x IP video outputs via NDI
 6. 2 x resolution-independent streaming video outputs
 7. 6 x video recording channels
 8. Multiviewer output (HDMI, DVI, or DisplayPort)
 9. 4 x Mix/Effect busses
 10. Robotic camera PTZ control via RS-232, RS-422, and IP
 11. Tally interface
- C. Perform all setup procedures and signal quality adjustments.
- D. As part of the installer's scope, provide and coordinate the services of a representative from the Vizrt Video division to be onsite to perform final setup and additional services, as well as provide a training session to the owner to fully operate the Tricaster Video Package.
- E. Furnish and Install the following, or approved equal:
 1. Broadcast Switcher (Installer shall be an authorized Vizrt TriCaster reseller and be factory certified for TriCaster system operation and training):
 - a. Vizrt Tricaster TC410 Plus in 2RU rackmount form factor. To be supplied with

- keyboard and mouse. (Qty: 1ea.)
- b. Vizrt Flex control panel for Tricaster devices. (Qty: 1ea.)
- c. Protek Ultra 1-year Coverage and Support Plan for Tricaster TC410 (Qty: 1ea.)
- d. Additional Vizrt Tricaster Remote Training - One day (8 hours) operator training for Vizrt Tricaster products that are installed at the facility. Training to be completed by a Vizrt Tricaster Authorized Trainer according to a predetermined training plan. (Qty: 1ea.)
- e. Audinate Dante Virtual Soundcard (DVS) license. Install this software, in conjunction with Audinate Dante Controller (freeware), on TriCaster computer. (Qty: 1 ea.)
- f. Henry Engineering LOGICONVERTER utility control logic interface. This device is for use between the Tricaster Tally Interface and GPIO Controller. Provide manufacturer's rackmount kit for mounting at equipment rack. (Qty: 1ea.)
- g. Skaarhoj ETH-GPI Link GPIO Controller with network interface. Configure with manufacturer's utility software for camera tally light control via Tricaster. (Qty: 1ea.)
- h. KVM Extender: Black Box KVXLCHDP-200 keyboard/video/mouse extender with dual monitor and USB 2.0 support. Provide all cabling and HDMI-DP / DP-HDMI adaptors, as required. Provide rackshelf for mounting at equipment rack. (Qty: 1ea.)

2.14 VIDEO ROUTING SWITCHER:

- A. Furnish a video production routing system to route, sync, and distribute video signals.
- B. Provide all cabling necessary for a complete working system.
- C. Configure routing equipment to connect and communicate over the AV network. Setup control of all available production equipment from the control room computer(s).
- D. Train the owner on how to access all production equipment over the AV network via the control booth computer(s). Setup system for easy access to video recorders for download onto an owner provided external hard drive.
- E. Furnish and install the following, or approved equal:
 - 1. AJA model KUMO 3232-12G 12G-SDI routing matrix switcher (Qty: 1ea.)
 - 2. AJA model KUMO CP2 remote control panel (Qty: 2ea.)

2.15 DISTRIBUTION, PROCESSING, AND CONVERSION

- A. Furnish devices for use in signal distribution, processing, and conversion.
- B. Furnish and Install the following, or approved equal:
 - 1. Card Frame and Modules:
 - a. AJA OG-X-FR card frame with power supply. (Qty: as shown)
 - b. AJA OG-3GDA-2x4 3G-SDI 2x4 reclocking distribution amplifier. (Qty: as shown)
 - c. AJA OG-3GDA-1x9 3G-SDI 1x9 reclocking distribution amplifier. (Qty: as shown)
 - d. AJA OG-UDC 3G-SDI Up, Down, and Cross-Converter. (Qty: as shown)
 - e. AJA OG-3G-AMA 3G-SDI analog audio embedder / de-embedder. (Qty: as shown)
 - 2. Standalone devices:
 - a. Blackmagic Design Mini Converter SDI to HDMI 6G converter with power supply. Provide rack shelf for mounting at equipment rack, where required. (Qty: as shown)
 - b. Blackmagic Design Mini Converter HDMI to SDI 6G converter with power supply. Provide rack shelf for mounting at equipment rack, where required. (Qty: as shown)

- shown)
c. Kiloview N3 SDI and NDI bi-directional converter. Provide RN01 rackmount kit for mounting at equipment rack. (Qty: as shown)

2.16 TEST AND MEASUREMENT

- A. Furnish a master reference generator for use with synchronizing video devices. Provide Sync to all compatible devices in the system.
- B. Unit shall be capable of providing composite or tri-level sync at SD and HD SDI signal rates.
- C. Furnish and install the following, or approved equal:
1. Ensemble Designs model Brighteye 57 Sync and Test Generator, to include power supply and BERKMT-FULL rackmount kit. (Qty: 1ea.)

2.17 VIDEO RECORDING

- A. Furnish a device for use with recording and playback of program video and audio.
- B. Furnish and install the following, or approved equal:
1. Blackmagic Design HyperDeck Studio HD Plus, to include Blackmagic Universal Rackshelf for mounting at control desk equipment bay. (Qty: 1ea.)
 2. Removable Media: SanDisk Extreme Pro UHS-II V90 SDXC 128GB SD Card. (Qty: 2 ea.)

2.18 VIDEO MONITORS AND ACCESSORIES:

- A. Furnish and install video displays, mounts, and cabling at locations shown in the drawings.
- B. Furnish and install signal converters where indicated in the drawings.
- C. Furnish and install the following, or approved equal:
1. Green Room portable studio display monitor:
 - a. Samsung QB65C 65" UHD flat panel display (Qty: 1ea.)
 - b. Chief LPAUB portable display cart. (Qty: 1ea.)
 2. Type TV-A Control Booth wall-mounted display:
 - a. Samsung QB55C 55" UHD flat panel display. (Qty: 1ea.)
 - b. Chief TS525TU Large THINSTALL Dual Swing Arm wall display mount (Qty: 1ea.)
 3. Control Booth desk-mounted displays:
 - a. Dell UltraSharp U2424H 24" IPS 120Hz display monitor. (Qty: 6ea.)
 - b. Mount at single arm mounts provided with Broadcast Control Desk.
 4. Rack Monitor: Blackmagic Design SmartScope Duo 4K dual 8" display with selectable video or waveform monitoring. Install configuration utility software on one of the Control Booth computers. (Qty: 1ea.)
 5. Type TV-B Hallway and AV Studio Flat Panel Displays:
 - a. Samsung QB65C 65" UHD flat panel display. (Qty: as shown)
 - b. Chief LTM1U Large Fusion Tilt Wall mount. (Qty: as shown)

2.19 CHARACTER GENERATOR

- A. Provide a graphics and titling solution compatible with the video production system. System shall be capable of animated graphics, animations, effects and transitions, lower thirds, crawls, main titles, real-time playout, automated sequencing and looping, and TriCaster macro control.
- B. Install computer, peripherals, and software for operation of character generator system.

- C. Provide and Install the following, or approved equal:
 - 1. NewBlue Captivate Broadcast titler and graphics software package (perpetual license). (Qty: 1ea.)
 - 2. Additional Training - 4 hours operator training for titler and graphics software package that is installed at the facility. Training to be completed by a NewBlue Authorized Trainer according to a predetermined training plan. (Qty: 1ea.)
 - 3. Dell XPS Desktop, minimum specs to include Intel Core i7-14700K processor, Windows 11 Pro, Nvidia GeForce RTX 4070 12GB GDDR6X graphics, 32GB Ram, 1TB SSD, wireless keyboard and mouse. Mount in Broadcast Control Desk lower storage bay below control position. (Qty: 1ea.)
 - 4. Capture / Playback Card: Blackmagic Design DeckLink Studio 4K PCIe card. Install in Character Generator computer. (Qty: 1ea.)

2.20 TELEPROMPTERS:

- A. Provide camera mounted teleprompter systems for each of the primary broadcast cameras.
- B. Teleprompters shall include all mounting hardware required to provide a full functional system with the cameras specified.
- C. Provide all cabling required to connect teleprompter systems to camera input plates.
- D. Install computer, peripherals, and software for operation of teleprompter system.
- E. Provide and Install the following, or approved equal:
 - 1. Prompter People Proline Plus Teleprompter Series model PROP-S17HB-15MM, with trapezoidal glass, 17" High Bright model with SDI input, 65/35 glass, and TeleScroll software package. (Qty: 2ea.)
 - 2. Provide 1ea. 30' Canare HD-SDI extra flexible 18AWG RG6 Coax cable to the monitor dressed with camera cables for each camera location (Qty: 2ea.)
 - 3. Dell Optiplex SFF computer system, minimum specs to include Intel Core i5 14500vPro processor, Windows 11 Pro, integrated graphics, 16GB RAM, 512GB SSD, wireless keyboard and mouse. Mount in Broadcast Control Desk lower storage bay below control position. (Qty: 1ea.)

2.21 STUDIO CAMERAS

- A. Furnish, assemble, and configure high definition professional camera systems with all accessories as listed. System to include camera, lens controllers, focus control, and viewfinders. Units to be supplied with lens, tripods, dollies, remote camera controllers, power supplies, fluid heads, and pan bars for a complete ENG and Studio Camera System.
- B. Configure cameras to be accessed and controlled over the AV network via the remote camera controllers in the control room.
- C. Provide and Install the following, or approved equal:
 - 1. JVC GY-HC500UN Professional Camera Recorder with SDI and NDI outputs. Each unit to include lens, lens hood, AC power adaptor and power cable, battery. (Qty: 2ea.)
 - 2. JVC HZ-MH600VZR LANC-compatible wired lens remote control. Mount on tripod handle. To be provided with SmallRig 2201 coiled male-to-female LANC extension cable. (Qty: 2ea.)
 - 3. JVC RM-LP250M multi-camera remote control panel. Route countertop at location shown and flush mount remote control panels at control position. (Qty: 1ea.)
 - 4. Marshall V-LCD70-AFHD 7" LCD On-Camera Monitor with Elvid SHOE-HD Heavy-Duty Camera Shoe mount Adapter and Elvid HDMI-A-015-C2 4k Coiled 1.5' HDMI cable. (Qty: 2ea.)

5. Canare HD-SDI extra flexible 18AWG RG6 Coax cable, 30-feet. (Qty: 2ea.)
6. Dual outlet power extension cable, black, 30-feet. (Qty: 2ea.)
7. Whirlwind ENC6SE030 Tactical Grade Cat6a ethernet cable, 30-feet. (Qty: 2ea.)
8. PortaBrace DVO-2 Camera Case (Qty: 2ea.)
9. Broadcast Camera Tripod System: Libec LX10-STUDIO 2-stage aluminum tripod system with H65B Head, Dual Pan Handles, and Spreader Dolly. (Qty: 2ea.)

2.22 ROBOTIC CAMERAS:

- A. Furnish and install high-definition robotic cameras at the locations shown in the drawings:
- B. Perform all setup procedures and signal quality adjustments.
- C. Configure pan/tilt/zoom IP control at the Broadcast Switcher.
- D. Furnish and install the following, or approved equal:
 1. Type "CA-PTZ" camera: Lumens VC-A61PN 4K NDI / HX PTZ Camera with VM12 Wall Mount. (Qty: as shown)

2.23 PODCAST SYSTEM:

- A. Provide an audio production system for recording podcasts.
- B. Install and configure all software on the specified computer under an owner-provided account (coordinate as necessary).
- C. Furnish and install the following, or approved equal:
 1. Podcast audio mixer: Rode RODECaster Pro2. (Qty: 1ea.)
 2. MicroSD Recording Media: SanDisk Extreme 512GB MicroSDXC UHS-I memory card with 190MB/s data rate. (Qty: 1ea.)
 3. Portable Podcast Desk: U-Line H-11093GR Mobile Activity Table, 72"x30" with casters, adjustable height, 1.25" thick laminate top, and heavy-duty steel legs. (Qty: 1 ea.)
 4. Recording Software: Avid Pro Tools Studio (perpetual license). Load and configure software on Character Generator computer. (Qty: 1ea.)
 5. Sony MDR-7506 headphones (Qty: 3ea.)
 6. Hosa HXSS-025 Pro Headphone Extension Cable, TRS male to female. (Qty: 2 ea.)
 7. Power Strip: Lowell Manufacturing ACS-1506-WW 6-outlet power strip with mounting tabs. Install at underside of podcast desk. Provide additional 25-foot power extension cord (black). (Qty: 1 ea.)

2.24 NETWORK MEDIA ENCODING / DECODING / DISTRIBUTION

- A. Furnish devices for use with encoding and decoding of Audiovisual signals over the dedicated AV-NET audiovisual data network. Devices shall support Gigabit Ethernet connectivity, and local DC or remote PoE+ power.
- B. Devices shall support up to, and including, 4K and UHD video resolution with ultra-low latency and visually lossless video. HDMI 2.0 and HDCP 2.2 shall be supported.
- C. System control shall be natively supported within the Audio DSP environment. Program Audio DSP system and associated touch control panel for individual encoder and decoder routing control to each endpoint location.
- D. Program associated audio routing within the specified Audio DSP system for each space via software Media Stream Receiver and Media Stream Transmitter devices.

- E. Furnish and install the following, or approved equal:
 - 1. Media Decoder at select "TV-B" Display Locations: Visionary Solutions D5100. Refer to drawings for specific locations. (Qty: 2 ea.)
 - 2. Media Encoder at "ER" AV equipment rack: Visionary Solutions E5100. Provide AVIP-Rackmount-3 rackmount kits to support all units. Provide AVIP-BLNK-1 at unpopulated spaces. (Qty: 1 ea)

2.25 MICROPHONES, STANDS, CABLES, DIRECT BOXES:

- A. Furnish microphones, stands, cables, and Direct Boxes for flexible use with the Broadcast and Podcast systems.
- B. Furnish and install the following, or approved equal:
 - 1. Talent Microphones: Shure MX185 wired cardioid condenser lavalier microphone with preamp module. (Qty: 4ea.)
 - 2. Studio Boom Microphones: Rode NTG1 supercardioid condenser shotgun microphone. For each unit supplied, provide Auray DUSM-1 microphone shockmount. (Qty: 2ea.)
 - 3. Podcast Microphones:
 - a. Shure SM7B dynamic cardioid vocal microphone (Qty: 3ea.)
 - b. Yellowtec YT3601-XLR m!ka Mic Arm M, black, with integrated XLR connections. (Qty: 3ea.)
 - c. Yellowtec YT3211 Bushing Mount for Mic Arm. Install at Podcast desk and Control Booth desk. (Qty: 3ea.)
 - 4. Utility Microphones: Shure SM58LC dynamic cardioid vocal microphone (Qty: 2ea.)
 - 5. Studio Boom Stands: AtlasIED SB36WE Studio boom stand with air suspension and casters, black. (Qty: 2ea.)
 - 6. Utility Stands: Atlas Sound TB3664 tripod microphone stand with boom, black. (Qty: 2 ea.)
 - 7. Microphone Cable: Whirlwind MKQ25NP-BLACK 25-foot microphone cable. (Qty: 8 ea.)
 - 8. Microphone Cable: Whirlwind MKQ50NP-BLACK 50-foot microphone cable. (Qty: 4 ea.)
 - 9. Instrument Cable: Whirlwind L15 Leader 15-foot instrument cable. (Qty: 2 ea.)
 - 10. Direct Box: Radial Engineering JDI passive direct box with Jensen transformer. (Qty: 1 ea.)
 - 11. Direct Box: Radial Engineering PRO-AV2 passive stereo multimedia direct box. (Qty: 1 ea.)

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Furnish components, racks, wire, cabinetry, connectors, materials, parts, equipment and labor necessary for the complete installation of the systems, in full accordance with the recommendations of the equipment manufacturers and the requirements of the drawings and specifications.
- B. Installation shall follow standard broadcast wiring and installation practice, and shall meet or exceed industry standards for such work, with particular attention given to any installation instructions in Part 2 of these Specifications.
- C. Equipment shall be held firmly in place with proper types of mounting hardware. All equipment affixed to the building structure must be self-supporting with a safety factor of at least five. All equipment shall be installed so as to provide reasonable safety to the operator and occupants. Supply adequate ventilation for all enclosed equipment items which produce heat.

- D. Furnish the system to facilitate expansion and servicing using modular, solid-state components. All equipment shall be designed and rated for continuous operation and shall be UL listed, or manufactured to UL standards.
- E. Observe proper circuit polarity and loudspeaker wiring polarity. No cables shall be wired with a polarity reversal between connectors with respect to either end. Special care shall be taken when wiring microphone cables, to ensure that constant polarity is maintained. Balanced audio connectors shall be wired as follows.

Wire	Connector	Signal
Black	Pin #3 or Ring	Negative
Red or White	Pin #2 or Tip	Positive
Bare	Pin #1 or Shield	Ground

- F. Provide all audio circuits balanced and floating, except as noted in the Specifications or directed by the Consultant at the time of final equalization and testing. Shields of audio cables shall be grounded at one end only, at the outputs of the various equipment items in the system.
- G. Route cables and wiring within equipment racks and cabinetry according to function, separating wires of different signal levels (video, microphone level, line level, amplifier output, 120VAC, intercom, control, etc.) by as much physical distance as possible. Neatly arrange and bundle all cables loosely with plastic cable ties. Cables and wires shall be continuous lengths without splices.
- H. All system wire, except spare wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No un-terminated wire ends will be accepted. Heat-shrink type tubing shall be used to insulate and dress the ends of all wire and cables. Include a separate tube for the ground or drain wire.
- I. All cables in conduits shall be insulated from each other and from the conduit the entire length and shall not be spliced. All cables and wires are to be continuous lengths without splices.
- J. All solder joints and terminations shall be made with rosin-core solder.
- K. Temperature regulated soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns or temperature unregulated irons shall be used on the job site.
- L. Mechanical connections shall be made using approved connectors of the correct size and type for the connection. Wire nuts will not be accepted.
- M. Each mechanical connector shall be attached using the proper size controlled-duty-cycle ratcheting crimp tool which has been approved by the manufacturer of the connectors. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on the job site.
- N. Label all wires in racks, backboxes, and console as to destination and purpose with permanent heat shrink labels.
- O. Clearly and permanently label all controls, connections, and equipment at the front and back of the rack with permanent Lamicoid labels. Attach laminated plastic labels with contact cement. Embossed or printed label tape, and press-on or lift-off lettering systems will not be accepted. All labeling shall be completed prior to final system inspection.

- P. Wall plates and custom panels shall be engraved and filled with contrasting paint, unless otherwise noted. All labeling shall be completed prior to final system inspection.

3.2 AUDIO SYSTEM FINAL TESTING AND EQUALIZATION:

- A. Installer shall perform thorough preliminary testing of the Audio-Video Systems prior to the final inspection by the Consultant. All systems and subsystems shall be tested to ensure that they are in proper working order and meet the performance specifications outlined in Part 3.3 below. Build the program for the digital signal processor and submit it to the consultant for review prior to commissioning. Install the processing program on the digital signal processor and test it for functionality.
- B. The completed Audio System shall be physically inspected by the Consultant to assure that all equipment is installed in a neat and professional manner, and in accordance with these Specifications. The Audio System shall be inspected and equalized by the Consultant, BAI, Dallas, Texas with assistance from the Installer. Provide a minimum of two weeks' notice to the Consultant for final inspection and equalization.
- C. The testing and equalization work shall be performed after the installation work has been completed, but prior to any use of the system. During the testing and equalization work, the Installer shall have on the job site at least one (1) competent technician who is familiar with the project, and who will be prepared to stay as long as his services are needed. It is estimated that approximately twelve (12) hours will be required for this work.
- D. The process of equalizing and testing the system may necessitate moving and adjusting certain loudspeakers. Adjustments shall be performed without claim for additional payment.
- E. Coordinate as necessary to ensure a totally quiet room during the Audio-Video systems testing and balancing period.
- F. Prior to requesting systems testing, verify the following:
- G. All systems are in first-class working condition and free of short circuits, ground loops, parasitic oscillations, excessive system noise beyond published specifications of the equipment, hum, RF interference, or instability of any form.
- H. All specified equipment, including loose and portable equipment is on the job site for proper accounting.
- I. All loudspeaker circuits have been tested, are connected to the proper crossover frequency, and are in perfect working order. Furnish impedance measurements of each circuit by facsimile transmission prior to final tests.
- J. All equipment controls are labeled, even if unused. If permanent labels cannot be furnished prior to system inspection, temporarily label every control as to its function with write-on tape. Supply labels or markers suitable for indicating knob settings after equalization is performed.
- K. Operation manuals for every equipment item furnished are on hand at the job site.
- L. Installer shall provide all signal processing software loaded on a portable PC and ready for use at time of testing. Installer shall provide a calibrated RTA and microphone, and pink noise generator at time of testing.
- M. Should the performance testing show that the Installer has not properly completed the systems, the Installer shall make all necessary corrections or adjustments and a second demonstration

shall be arranged at the Installer's expense.

- N. The final acceptance of the system by the Owner will be based upon the report of the Consultant following inspection, testing, and demonstration. A list of items in need of completion or correction shall be prepared by the Consultant, which must be corrected by the Installer before final acceptance will be granted.

3.3 OWNER TRAINING AND FAMILIARIZATION:

- A. The Installer shall furnish the Owner's representatives with training necessary to properly operate the systems. Demonstrate in detail all functions of the systems. Provide a minimum of 16 hours for this basic training, broken up into several training sessions, at the discretion of the owner. Training sessions will be allowed to take place throughout the warranty period. These training sessions shall be videotaped by the installer and copies provided to the Owner with the as-built documentation.

END OF SECTION 27 41 15

27 50 00 – IN-BUILDING CELLULAR AMPLIFICATION SYSTEM

PART 1 - GENERAL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.01 RELATED WORK

- A. All Division 26, 27 & 28 as it relates to this scope of work.

1.02 SECTION INCLUDES

This specification describes technical and performance criteria for deploying a In-Building Cellular Amplification System capable of supporting Wireless Service Providers (WSP). The components specified in this document include: Donor Antennas, Coverage Antennas, Coax Cable, Singlemode duplex fiber, composite fiber with singlemode duplex and 16/2 AWG copper, and analog repeater.

1.03 SYSTEM DESCRIPTION

- A. Services: Upon commissioning, the In Building cellular amplification system shall provide coverage for the WSPs listed below on all frequencies currently being used by the designated WSPs in the given market that has an exterior signal level is -105 dBm RSRP or greater.

1. AT&T
2. Sprint
3. T-Mobile
4. Verizon
5. US Cellular

<u>Service</u>	<u>Downlink</u>
Cellular	870 - 894
PCS	1930 - 1995
AWS	2110 - 2155
700 LTE	728 - 756

- B. WSP Notification: The Contractor shall register the repeaters with at least one WSP through their web site that the repeaters will be connected to the WSPs' macro networks.

1.04 ALTERNATIVES

- A. No alternative component(s) shall be accepted as equal to the components and manufacturers specified in this document

1.05 CODES, STANDARDS AND CERTIFICATIONS

- A. All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing shall comply with the latest editions of the National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractors Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the contractor shall satisfy the most stringent requirements.
- B. It is the Contractor's responsibility to ensure that the components comply with

local code, ordinances or requirements established by the AHJ.

1.05 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authority Having Jurisdiction
- B. ATP: Acceptance Test Plan
- C. AWS: Advanced Wireless Service
- D. BDA: Bi-Direction Amplifier
- E. BOM: Bill-of-Material
- F. DAS: Distributed Antenna System
- G. DAQ: Digital Audio Quality
- H. ESMR: Enhanced Specialized Mobile Radio
- I. FCC: Federal Communications Commission
- J. iDEN: Integrated Enhanced Digital Network
- K. LMR: Land Mobile Radio
- L. LTE: Long Term Evolution
- M. MTBF: Mean Time Between Failure
- N. NFPA: National Fire Protection Association
- O. NMS: Network Management System
- P. PCS: Personal Communications System
- Q. PSN: Public Safety Network
- R. RoF: Radio-over-Fiber
- S. RoHS: Restriction of Hazardous Substances
- T. RSL: Received Signal Level
- U. SIMO: Single-Input, Multiple-Output
- V. SISO: Single-Input, Single-Output
- W. SMR: Specialized Mobile Radio
- X. SMS: Short Message Service
- Y. SNMP: Simple Network Management Protocol
- Z. SOW: Statement of Work
- AA. VSWR: Voltage Standing Wave Ratio
- BB. WSP: Wireless Service Provider

1.06 DEFINITIONS

- A. Acceptance: Expressed approval by the customer
- B. Active: Components that require AC/DC power for operation
- C. Channel: A path for an RF transmission between two points
- D. Component: A main system element of the Amplification system
- E. Contractor: The prime contractor bidding the project
- F. Delivered Audio Quality (DAQ): A measure of audio quality over a transmission medium used to quantify the quality of audio heard over a radio system. DAQ levels are defined by the following scale:
 - a. DAQ 1: Unusable. Speech present but not understandable.
 - b. DAQ 2: Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.
 - c. DAQ 3: Speech understandable with slight effort. Requires occasional repetition due to noise or distortion.
 - d. DAQ 3.4: Speech understandable without repetition. Some noise or distortion present.
 - e. DAQ 4: Speech easily understandable. Little noise or distortion.
 - f. DAQ 5: Perfect. No distortion or noise discernible.
- G. Sub-contractor: A qualified and experienced integrator performing the

deployment for the Contractor.

- H. Head-End Equipment: The equipment that accepts the RF Source, and then typically amplifies the RF source to the interior antennas
- I. Passive: Components that do not require AC/DC power for operation

1.07 PERFORMANCE REQUIREMENTS

A. WSP :

1. On a per channel basis, the downlink RSL for each frequency band shall meet or exceed the criteria in Table 1.

Table 1. System Parameters

Parameters	Unit	700 LTE	Cellular, PCS, AWS, Commercial 800 MHz
Minimum downlink receive signal RSRP	dBm	-105	-105

2. Contractor shall state the assumed channel loading and frequency bands for the proposed WSP in-building coverage. Prior to installation, contractors shall confirm the channel loading and frequency use in the serving area and shall guarantee coverage for these channels per the criteria in Table 1.
3. The system shall deliver coverage per the criteria in Table 1 throughout 95% of the building.

1.08 SUBMITTALS

A. Submittal Requirements:

1. Product Data: Submit manufacturer datasheets for the following components:
 - a. Coverage Antennas
 - b. Coaxial Cable
 - c. Singlemode duplex Fiber
 - d. Repeaters
 - e. Masts
 - f. Donor antennas
2. Shop Drawings: Submit the following items:
 - a. RF link budget
 - b. Overlay of system Components on floor plans
 - c. Drawings for Donor Antenna and grounding
 - d. Bill-of-Material (BOM)
3. Statement of Work (SOW): Submit sample SOW
4. Acceptance Test Plan (ATP): Submit sample ATP
5. Recommended Spares
6. Warranty Documents:
 - a. Submit for all manufactured Components specified in this Section.
 - b. Submit Contractor's System Warranty.
 - c. Submit Manufacturer's Warranty.

B. Submittal Requirements Prior to Start of Construction

1. Final RF link budget

2. Overlay of system Components on floor plans
 3. Drawings for Donor Antenna and grounding
 4. RF propagation modeling
 5. Bill-of-Material (BOM)
 6. Maintenance Service Contract
 7. Statement of Work (SOW): The contractor shall submit a SOW that has been accepted by the customer or customer's designated representative.
 8. Acceptance Test Plan (ATP): The contractor shall submit an ATP that has been accepted by the customer or customer's designated representative.
- C. Submittal Requirements at Close Out
1. Drawings: Submit as-built drawings indicating:
 - a. Donor antenna, grounding and lighting protection details
 - b. Cable routing, splitters, couplers and coverage antenna locations
 - c. Active component locations, layout and configuration
 2. Test Reports
 - a. WSP: Submit accepted ATP reports confirming the requirements of this specification have been met.
 3. Field Reports: Submit sweep-testing results for all cable runs.
 4. Operation and Maintenance Data: Submit hardware manuals for all Components.
 5. Warranty Documents:
 - a. Submit for all manufactured components specified in this Section.
 - b. Submit Contractor's System Warranty.
 - c. Submit Manufacturer's Warranty

1.09 QUALITY ASSURANCE

- A. Qualifications and Requirements:
1. Contractor or Sub-contractor shall have a minimum of 4-years full-time experience executing work of similar scope and complexity.
 2. Contractor or Sub-contractor shall have deployed a minimum of 10 systems.
 3. Contractor or Sub-contractor Project Managers must be System Certified.
 4. Contractor or Sub-contractor shall provide an onsite construction foreman to oversee the installation.
 5. Contractor or Sub-contractor shall provide a project manager to oversee the deployment.
- B. Certifications:
- a. The manufacturer(s) of the active components shall maintain a formal authorized and certified value-added reseller program, which consists of routine quality audits of the participating value-added resellers. The list of authorized value-added resellers shall be published and the Contractor or Sub-contractor shall be listed in the Manufacturer's publication of value-added resellers.
 - b. Contractor or Sub-contractor(s) shall provide manufacturer certification that their personnel have been trained on the passive and active components being installed.
 - c. Contractor or Sub-contractor shall be an authorized and certified value-added reseller for the proposed manufacturer of passive and active components.

1.10 WARRANTY

- A. Manufacturer Warranty:
1. Splitters, Couplers and Coverage Antennas: 5-year limited warranty from date of system acceptance.
 2. Coaxial Cable and Connectors: 10-year limited warranty from date of system acceptance.
 3. Active Components: The earliest of 3-year limited warranty from date of system installation or 15 months from date of shipment.

1.11 MAINTENANCE

- A. The Contractor shall provide an optional annual maintenance service contract to include:
- Diagnostics & Repair
 - 24x7x365 Technician Dispatch (On-site within 24 hours)
 - Annual Preventive Maintenance
 - Equipment Warranty Management

PART 2 – PRODUCTS

1.01 MANUFACTURERS

1. Specified Manufacturers for 50 Ohm passive components:
Wilson Electronics
Specified Manufacturers for Active components: Wilson Electronics and Zinwave
2. Acceptable Manufacturers: Wilson Electronics Pro Series Equipment and Zinwave

1.02 COMPONENTS

Cellular Repeater

Single Output Amplifier

- A. Single Input Single Output (SISO) wall mount or rack mount cellular repeater shall provide up to +17 dBm downlink power and +26 dBm uplink power with maximum of 70dB gain that is compatible with all North American cell networks
- B. The cellular rep
- C. The cellular repeater shall incorporate eXtended Dynamic Range (XDR) technology to protect the amplifier from shutting down due to strong outside signal (-40dBm or higher) or changes in the outside signals.
- D. The cellular repeater shall incorporate Multi-Tower Targeting (MTT) technology to target specific frequency bands from multiple macro antennas.
- E. The cellular repeater shall incorporate cloud integration for remote monitoring and management. Connectivity to the cloud shall be via LTE connection (using built-in cellular modem) or wired ethernet connection.
- F. The cellular repeater shall auto-detect and prevent any cell tower interference.
- G. Frequencies:
- | | |
|--------------|--------------|
| a. Band 12 | 700MHz |
| b. Band 13 | 700MHz |
| c. Band 5 | 850MHz |
| d. Band 4 | 1700/2100MHz |
| e. Band 25/2 | 1900MHz |

1.03 Multiple Output Amplifier

- A. Single Input Multiple Output (SIMO) wall mount or rack mount cellular repeater shall provide up to +17 dBm downlink power and +26 dBm uplink power with maximum of 70dB gain from the input to each of (4) outputs and is compatible with all North American cell networks
- B. The cellular repeater shall incorporate eXtended Dynamic Range (XDR) technology to protect the amplifier from shutting down due to strong outside signal (-40dBm or higher) or changes in the outside signals.
- C. The cellular repeater shall incorporate Multi-Tower Targeting (MTT) technology to target specific frequency bands from multiple macro antennas.
- D. The cellular repeater shall incorporate cloud integration for remote monitoring and management. Connectivity to the cloud shall be via LTE connection (using built-in cellular modem) or wired ethernet connection.
- E. The cellular repeater shall display RSRP & RSRQ (network scanning) on the LCD referenced to the indoor (server) ports. This represents signal performance after it has been amplified and shall also be available through cloud integration for troubleshooting purposes.
- F. The cellular repeater shall auto-detect and prevent any cell tower interference.
- G. The solution shall have the capability of conversion to RF over fiber utilizing duplex singlemode fiber for backbone distribution and composite duplex singlemode fiber and 16/2 AWG copper for horizontal cabling to remote units.
- H. Frequencies:
 - f. Band 12 700MHz
 - g. Band 13 700MHz
 - h. Band 5 850MHz
 - i. Band 4 1700/2100MHz
 - j. Band 25/2 1900MHz

1.04 Outside Antennas

- A. Omni-Directional Outside Antennas: Omni-Directional outside antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.
- B. Electrical Band 1:
 - k. Frequency Band: 698 – 800 MHz
 - l. VSWR: < 1.8
 - m. Gain: 2 dBi
 - n. Maximum input power: 100W
 - o. Impedance: 50 Ω
 - p. Beamwidth, Horizontal: 360° omnidirectional
 - q. Beamwidth, Vertical: 60° nominal
- 1. Electrical Band 2:
 - a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
 - b. VSWR: 1.5:1
 - c. Gain: 5 dBi
 - d. Maximum input power: 100W
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 360° omnidirectional
 - g. Beamwidth, Vertical: 60° nominal
- 2. Mechanical:
 - a. Connector: 50 Ω N Type Female
 - b. Mounting: Mast Mount

- c. Radome material: ABS, UV resistant
- d. Pigtail cable: KSR195, plenum rated
- 3. Environmental:
 - a. Application: Outdoor
 - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - c. Relative Humidity: Up to 100%
- 4. Regulatory Compliance/Certifications: RoHS 2002/95/EC

Outside Directional Antennas (YAGI): Outside Directional antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.

- C. Electrical Band 1:
 - a. Frequency Band: 698 – 800 MHz
 - b. VSWR: < 1.8
 - c. Gain: 2 dBi
 - d. Maximum input power: 100W
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 360° omnidirectional
 - g. Beamwidth, Vertical: 60° nominal
- 1. Electrical Band 2:
 - a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
 - b. VSWR: <1.8
 - c. Gain: 4 dBi
 - d. Maximum input power: 100W
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 360° omnidirectional
 - g. Beamwidth, Vertical: 60° nominal
- 2. Mechanical:
 - a. Connector: 50 Ω N Type Female
 - b. Mounting: Thru-hole ceiling mount
 - c. Radome material: ABS, UV resistant
 - d. Pigtail cable: KSR195, plenum rated
- 3. Environmental:
 - a. Application: Indoor
 - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - c. Relative Humidity: Up to 100%
- 4. Regulatory Compliance/Certifications: RoHS 2002/95/EC

Inside Antennas

- D. Omni-Directional Coverage: Omni-Directional Coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.
- E. Electrical Band 1:
 - a. Frequency Band: 698 – 800 MHz
 - b. VSWR: 1.5:1
 - c. Gain: 7 dBi
 - d. Maximum input power: 50 watts
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 360° omnidirectional
 - g. Beamwidth, Vertical: 60° nominal
 - h. Return Loss: 10.9 dB

1. Electrical Band 2:
 - a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
 - b. VSWR: 1.5:1
 - c. Gain: 7 dBi
 - d. Maximum input power: 50 watts
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 360° omnidirectional
 - g. Beamwidth, Vertical: 65° nominal
 - h. Return Loss: \leq 13.9 dB
 2. Mechanical:
 - a. Connector: 50 Ω N Type Female
 - b. Mounting: Thru-hole ceiling mount
 - c. Radome material: ABS, UV resistant
 - d. Pigtail cable: KSR195, plenum rated
 3. Environmental:
 - a. Application: Indoor
 - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - c. Relative Humidity: Up to 100%
 4. Regulatory Compliance/Certifications: RoHS 2002/95/EC
- F. Low Profile Omni-Directional Coverage: Omni-Directional Coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.
- G. Electrical Band 1:
- i. Frequency Band: 698 – 800 MHz
 - j. VSWR: 1.5:1
 - k. Gain: 7 dBi
 - l. Maximum input power: 50 watts
 - m. Impedance: 50 Ω
 - n. Beamwidth, Horizontal: 360° omnidirectional
 - o. Beamwidth, Vertical: 60° nominal
 - p. Return Loss: 10.9 dB
1. Electrical Band 2:
 - i. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
 - j. VSWR: 1.5:1
 - k. Gain: 7 dBi
 - l. Maximum input power: 50 watts
 - m. Impedance: 50 Ω
 - n. Beamwidth, Horizontal: 360° omnidirectional
 - o. Beamwidth, Vertical: 65° nominal
 - p. Return Loss: \leq 13.9 dB
 2. Mechanical:
 - e. Connector: 50 Ω N Type Female
 - f. Mounting: Thru-hole ceiling mount
 - g. Radome material: ABS, UV resistant
 - h. Pigtail cable: KSR195, plenum rated
 3. Environmental:
 - d. Application: Indoor
 - e. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - f. Relative Humidity: Up to 100%
 4. Regulatory Compliance/Certifications: RoHS 2002/95/EC
- H. Directional Coverage Antennas: Directional coverage antennas shall feature a

multi-band design, accommodating multiple frequency bands in a single small antenna.

1. Electrical Band 1:
 - a. Frequency Band: 698 – 800 MHz
 - b. VSWR: 1.5:1
 - c. Gain: ≥ 5.0 dBi @ 698 – 800 MHz
 - d. Maximum input power: 50W
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 70/60°
 - g. Polarization: Vertical
 - h. Return Loss: ≤ 10.9 dB
 2. Electrical Band 2:
 - a. Frequency Band: 1710 – 2700 MHz and 800 – 960 MHz
 - b. VSWR: $\leq 1.5:1$
 - c. Gain: ≥ 5.0 dBi @ 800 – 960 MHz and ≥ 8.0 dBi @ 1710 – 2170 MHz
 - d. Maximum input power: 50W
 - e. Impedance: 50 Ω
 - f. Beamwidth, Horizontal: 70/60°
 - g. Return Loss: ≤ 13.9 dB
 3. Mechanical:
 - a. Connector: 50 Ω N Type Female
 - b. Mounting: 4-hole wall mounting plate
 - c. Radome material: ABS, UV resistant
 - d. Pigtail cable: RG58, plenum rated
 4. Environmental:
 - a. Application: Indoor
 - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - c. Relative Humidity: Up to 100%
 5. Regulatory Compliance/Certifications: RoHS 2002/95/EC
- I. Air Dielectric, Plenum Rated Cable:
1. Material Characteristics:
 - a. Jacket: Halogenated, Fire-Retardant
 - b. Outer Conductor Material: Corrugated Aluminum or Corrugated Copper
 - c. Inner Conductor Material: Copper-Clad Aluminum Wire
 2. Electrical Characteristics:
 - a. Impedance: 50 \pm 2.0 Ω
 - b. Frequency Band: 1 - 8800 MHz
 - c. Peak Power Rating: ≥ 40.0 kW
 3. Mechanical Characteristics:
 - a. Diameter Over Jacket: $\leq .627$ in
 - b. Minimum Bending Radius: ≤ 5 in
 - c. One Time Minimum Bending Radius: ≤ 3 in
 4. Attenuation Characteristics:

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.848
450	≤ 1.53
800	≤ 2.105
2000	≤ 3.564

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

J. Foam Dielectric Cable:

1. Material Characteristics:
 - a. Jacket: Non-halogenated, Fire-Retardant Polyolefin
 - b. Outer Conductor Material: Corrugated Copper
 - c. Inner Conductor Material: Copper-Clad Aluminum Wire or Copper Tube
2. Electrical Characteristics:
 - a. Impedance: $50 \pm 1.0 \Omega$
 - b. Frequency Band: 1/2" Nominal: 1 - 8800 MHz, 7/8" Nominal: 1 - 5000 MHz
 - c. Peak Power Rating: $\geq 40.0 \text{ kW}$
3. Mechanical Characteristics:
 - a. Diameter Over Jacket: 1/2" Nominal: $\leq .630 \text{ in}$, 7/8" Nominal: $\leq 1.1 \text{ in}$
 - b. Minimum Bending Radius: 1/2" Nominal: $\leq 5 \text{ in}$, 7/8" Nominal: $\leq 10 \text{ in}$
 - c. One Time Minimum Bending Radius: 1/2" Nominal: $\leq 2 \text{ in}$, 7/8" Nominal: $\leq 5 \text{ in}$
4. Attenuation Characteristics: 1/2" Nominal

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.815
450	≤ 1.447
800	≤ 1.968
2000	≤ 3.251

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Attenuation Characteristics: 7/8" Nominal:

Frequency (MHz)	Attenuation (dB/100ft)
150	≤ 0.417
450	$\leq .744$
800	≤ 1.014
2000	≤ 1.683

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

K. Splitters, Taps, Couplers, and Coax Jumpers:

1. Approved Manufacturer: Wilson Electronics

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The contractor and/or Sub-contractor shall design, install, commission and test the Cellular amplification system in accordance with the manufacturer's instructions and recommendations.
- B. The contractor and/or Sub-contractor shall install the Cellular amplification system in accordance with the accepted SOW.
- C. The contractor and/or Sub-contractor shall adhere to all work and safety requirements while working at the job site.
- D. The contractor and/or Sub-contractor shall have Cellular amplification system

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- project foreman on site overseeing the installation.
- E. The contractor and/or Sub-contractor shall have at a minimum one Project Manager on staff overseeing the project. The Project Manager will be responsible for the following:
 - 1. Developing and maintaining a project plan consistent with the overall milestones of the project.
 - 2. Overseeing and coordinating the activities of the Cellular amplification system project, including: initiating and holding weekly project conference calls, as well as maintaining and distributing meeting minutes.
 - 3. Act as the point-of-contact interface for all Cellular amplification system project activities.
 - 4. Provide weekly status updates regarding work performed, worked scheduled, open items, problems/issues and resolutions.
 - F. The contractor and Sub-contractor shall be prepared to deploy the Cellular amplification system in a phased approach as dictated by the building construction and/or work of other trades.
 - G. The contractor and Sub-contractor shall be WilsonPro Certified
 - H. All singlemode fiber connections shall be SC/ APC. No mechanical terminations. Fusion splicing only.
 - I. No more than 5dB optical loss and 35dB back reflection per optical link.
 - J. The contractor and Sub-contractor shall facilitate WSP registration and connection to their respective macro networks.
 - K. The contractor and Sub-contractor shall be prepared to connect to the WSP's network(s) in a phased approach as dictated by the construction schedules.
 - L. Install cabling designed for the environment the cable will be installed in.
 - M. Terminate and test all coaxial cabling with a sweep analyzer.
 - N. Test all fiber cabling utilizing level 3 tester or above
 - O. Label all cabling per the contract drawings to indicate the segment number from each amplifier.
 - P. Provide exterior cell measurements according to the manufacturers recommendations.

3.02 ACCEPTANCE TESTING

- A. Acceptance testing will be performed confirming the requirements of Section 1.07 have been met.
- B. The contractor shall complete the acceptance testing per the requirements and as prescribed in the approved Acceptance Test Plan (ATP) submittal.
- C. Acceptance Testing
 - 1. Acceptance Testing shall comply with the following:
 - a. The Acceptance Test shall ensure that two-way coverage on each floor of the building meets the minimum coverage requirements detailed in Section 1.07.
 - b. Tests shall be made using the frequencies listed in Section 1.02.A.
 - c. Testing shall be coordinated with the Customer and AHJ to ensure no undue interference to any building operations.
 - d. All testing shall be done on frequencies authorized by the FCC.
 - 2. Test Procedures
The test plan shall ensure testing throughout the building. Testing shall be performed on a grid system. A spot located approximately in the center of a grid area will be selected for the test. Once the spot has been selected, prospecting for a better spot within the grid area will not be permitted. A grid is overlaid onto a floor area to provide 20 grid cells. Grid cells are provided with definite minimum and maximum dimensions. For most buildings, using a minimum grid dimension of 20 ft and a maximum grid

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dimension of 80 ft will suffice to encompass the entire floor area. A maximum of one area will be allowed to fail the test (95% coverage). Where a floor exceeds the sq ft, which is the floor area that can be covered by the system, the floor be subdivided into 40 equal sectors, with each sector being tested individually. A maximum of two non-adjacent areas will be allowed to fail the test (95% coverage). In addition to the above requirement, all critical areas, which include; the emergency command center(s), the fire pump room(s), exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations, and other areas deemed critical by the AHJ, shall be provided with 99 percent floor area radio coverage. Signal strength measurements shall be performed using standardized parameters as specified below.

3. Measurement Parameters

Signal levels shall be measured to ensure the system meets the criteria specified in the Technical Proposal. Downlink measurements shall be made with the following standardized parameters:

1. Measurements shall be recorded using a calibrated automatic signal-level measurement system measuring RSRP in each band with a dipole antenna positioned approximately 4' above the surface.
2. Measurements will be recorded for the test pattern as described above.
3. System acceptance is achieved when 95% of the averaged data points meet or exceed the requirements specified here and in Section 1.07.

END OF SECTION

SECTION 27 51 23 – INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED WORK

- A. 26 05 00 – Grounding and Bonding
- B. 26 05 29 – Electrical Hangers and Supports
- C. 26 05 33 – Raceway and Boxes

1.2 APPROVED MANUFACTURERS

- A. Carehawk Safety Communications Systems

1.3 GENERAL REQUIREMENTS

- A. The intent of this specification is to provide a complete and properly operating, distributed, digital telephonic communications system for the pick-up, amplification, distribution and reproduction of voice and/or other audio program material and time keeping functions. The system shall be of modular design to facilitate both expansion and service and shall be completely solid state. All necessary hook-up and testing shall be by a factory approved representative.
- B. The system assemblies shall be completely factory built and tested by manufacturers of established reputation, who have and can refer to similar systems which are currently installed and functioning properly. The factory pre-assembled cabinets, consoles, and power supplies shall be UL approved and listed.
- C. The system shall be guaranteed for a period of five (5) years from the date of acceptance or first beneficial use, whichever is first, against defects in materials, workmanship, design and improper adjustment. Any defects in the system shall be corrected at no expense to the Owner, provided the system does not show signs of abuse. During the guarantee period any work found not to be in conformance with the plans, specifications and addenda shall be brought into conformity with same at no additional cost to the owner.
- D. The equipment described herein, and furnished per these specifications shall be supplied and installed by one communications contractor. The contractor shall hold the necessary License for this type of work. All reference to model numbers and other detailed descriptive data is intended to establish standards of design, performance, and quality as required. Contractor is required to submit current certification from manufacturer with submittals.
- E. The communications contractor shall furnish all equipment, accessories and material required for the installation of a comprehensive Intercom / Telephone / Clock Communications System in strict compliance with these specifications and applicable contract drawings. Any material and/or equipment not specified or described herein necessary for the proper operation of the system shall be deemed part of this specification.
- F. The contractor shall instruct personnel designated by the owner in the proper use, basic care, and maintenance of the equipment. Such training shall be provided as an integral component of the system.

- G. The intercom contractor is responsible for all data cabling connections from MDF/IDF headend closets to intercom headend equipment. Coordinate with project data contractor on cabling routing and termination connection points. All data cabling connections to campus network shall be performed by project data contractor who is certified to install network data cabling per Owner's data cabling certification requirements.

1.2 CONTRACTOR QUALIFICATIONS

- A. The installing contractor shall be the authorized representative of the intercom system to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the intercom manufacturer's product for at least five years.
- B. The contractor shall make available, and maintain a 24 hour, 365 days per year dispatched mobile service department capable of furnishing equipment inspection and timely service at the owner's location.
- C. The contractor shall be prepared to offer a service contract for the maintenance of the system beyond the warranty period.
- D. **The installing contractor must have a permanent office within a 75 mile radius of the project site and be a approved dealer/integrator, of the proposed system, in the nearest major metropolitan area.**
- E. The system shall be supplied by the manufacturer's authorized contractor. Certification shall be submitted verifying that the contractor is the manufacturer's authorized contractor. Included shall be certificates of attendance in manufacturer's installation / maintenance training by the contractors directly employed personnel. The communications contracting company shall have been in business for a minimum of 5 years, continuously furnishing the specified manufacturers' product lines and systems.
- F. **All individuals installing the intercom system must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.**
- G. **The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing intercom system contractor will be allowed for any portion of the fire alarm system scope of work.**
- H. The contractor shall submit certificates of factory authorization and completion of the manufacturer's installation and maintenance training.
- I. Acceptable manufacturers:
 - 1. The system specified shall be that of Carehawk Safety Communications Systems
 - 2. No other manufacturers will be accepted.

1.4 SUBMITTALS

- A. Provide submittals in as follows:
 - 1. Shop drawings: Provide wiring diagrams clearly indicating proposed equipment and

- interconnection of all internal and external components. Include dimensional details of all mounting including rack elevations and ergonomic layouts. Submit to architect for approval prior to fabrication.
2. In addition to the above listed items, the submitted drawings shall show the following:
 - a. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - b. Location of sleeved wall pass-thru
 - c. Size of sleeve at each location installed
 - d. Quantity of cable passing through each sleeve
 3. Provide complete catalog cuts of all major components including but not limited to:
 - a. Intercom / Telephone / Clock Equipment Racks and Equipment.
 - b. Administrative and Staff Telephone Stations, Station Controls and Displays.
 - c. Classroom and Station Equipment, Jacks, and terminations
 - d. Classroom and Hallway "Amplified Voice" Speakers, Outside Paging Speakers Back boxes and Specialty Rough-Ins
 - e. Wire, Cable, Jacks and Termination fields
 4. Provide an AUTOCAD engineering floor plan diagram, in 11 inches X 17 inches size format, of the system installation details indicating wiring lay-out, proposed wire routing, rough-in and installation information.
 5. Specification Compliance: A letter shall be provided stating, by section and subsection, that the intercom system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
 6. Drawing Compliance: A letter shall be provided stating that the intercom system installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- B. Certifications/Licensing: The contractor shall submit all of the following certifications/licensing and the all must contain dates which are valid from the date of proposal and not expire any sooner than 12 months after substantial completion of the project.
1. State Licenses as applicable to this system
 2. Manufacturer's Authorized Dealer Certification
 3. Manufacture Installer Training Certificate (required for at least 25% of all installers on site.)

1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide 3 qty. complete bound O&M manuals describing maintenance and operation of the system. Include descriptions and service data on all component parts. Manual shall also include the following:
1. Warranty Statement indicating effective dates.
 2. Complete engineering data on all systems furnished including schematics of all equipment, shop drawings on all specially fabricated items, wiring diagrams of the

INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

system in its "as built" condition.

3. Instructions on operational procedures, including master and substation operation, standard and special codes and alarm or maintenance indications and procedures.
4. A listing of all stations connected to the system, the power drawn by each speaker circuit, and the total load in watts connected to the amplifiers.
5. All system programming information and forms.
6. Also provide O&M manuals in digital format (pdf) on 2 qty. 8MB thumb drives.

1.6 SCOPE

- A. Provide a complete and comprehensive distributed, multi-channel, micro-processor School Communications / Clock system integrated with existing intercom / clock and bell system. The system shall incorporate integrated Speaker Intercom and fully non-blocking Digital Telephone systems with connection to outside telephone lines as specified. All system functions shall be enabled by DTMF/microprocessor control. The communications system shall be provided by one supplier to assure smooth coordination of all communications needs. The system shall have the capabilities of processing voice/data transmission at the standard ISDN basic rate interface (BRI).to and from any administrative telephone station. The system shall accept direct DS-1 level interfaces.
- B. Provide wire guards on all devices in gymnasiums/
- C. Clocks shall be 120v or 24v, no batteries.
- D. Provide 3 administrative phones per campus. (front reception, principal and principal secretary).
- E. Integrate campus intercom system to owner's IP phone system.
- F. Size system for 15% spare capacity of zones. Provide 12 spare circuits for future portable buildings (not to be part of the 15% spare capacity).
- G. Separate exterior zones from interior zones.
- H. Provide wall mounted volume control next to door for all conference rooms, offices, library and special needs rooms.
- I. Each classroom shall be individually zoned. Corridors are grouped per floor plan area.
- J. Label all wiring at termination points as per actual room numbers.
- K. All intercom wiring shall be sized correctly based on distance and number of devices being connected.
- L. Provide network capability to allow for remote programming.

1.7 FUNCTION – INTERCOM

- A. GENERAL: The system shall provide the state of the art in distributed technology and include but not limited to; priority based access to voice functions, emergency call-in, covert PC based call-in, pre-recorded emergency announcements, external and internal telephone access, integrated

video surveillance, secondary clock corrections, bell schedule and optional district wide communications functions. The system shall contain RS232, RS485, USB, and Ethernet ports for communication to third party systems. The system shall be easy to learn and operate using Windows based software. All standard system programming shall be user friendly to allow the system administrator the ability to easily program system features both locally and from remote locations.

- B. Provide complete and satisfactorily operating Integrated Intercom/Communications System as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

1.8 FUNCTION - MASTER CLOCK:

- A. Carehawk Safety Communications Products – CH1000. Provide an internal master clock with the following features:
1. Non-volatile memory capacity for storing unlimited schedules with unlimited events on each schedule. Ability to review, edit and delete events. Fully automatic calendar execution capable of future event programming to 30 years. Automatic Daylight Savings Time change with leap year programming. Interface with Dukane, Sapling, Rauland, National Time and Signal, American Time and Signal, Simplex and Latham secondary clocks whether synchronous wired or electronic. Output relays rated at 5 amperes shall be provided on all zone circuits as necessary. Lithium battery will provide not less than 5 years battery back-up for timekeeping function.
 2. The master clock shall be capable of being synchronized by a Network Time Server (NTP).
 3. Provide master clock system with automatic daylight savings and anatomic clock signal capabilities.
 4. Provide for scheduling of tone events, output events, program source events and video camera events.
 5. Secondary clocks for elementary schools shall be single or double faced, analog, corrective, 12" round display according to floor plan, unless noted otherwise. Secondary clocks for high schools shall be 4 inch digital LED clocks single or double faced according to floor plan. Provide protective guards in high activity areas and gymnasiums.
 6. Provide semi-flush back boxes for all single face clocks.
 7. Clock power supply: provide secondary clock power supply. Power supply shall be sized in quantity to meet the load requirements of the system.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Carehawk CH1000: Furnish and install a microprocessor-controlled voice, telephone, communications and clock system with all conduit, wire, outlets, and equipment as shown on the drawings and as herein specified to provide a complete sound, program distribution, and voice intercommunications system in the building.

1. DA1

- a. Furnish and install the required administrative telephones (DA1) with all conduit, wire, outlets, and equipment as shown on the drawings.

2. CTCL

- a. Furnish and install the required Caller ID telephones (CTCL) with all conduit, wire, outlets, and equipment as shown on the drawings.
- b. General—For the purposes of this specification, a Caller ID capable telephone that is connected to the CH1000 System through the Analog Telephone Interface (VFS16/32) shall be referred to as a CTCL. A CTCL is a standard off the shelf display telephone that can be wired or wireless. Various types can be intermixed throughout the system. They may or may not include a speaker phone feature. Note that system audio quality/intelligibility is dependent on these telephones.

3. STEL

- a. Furnish and install the required single line telephones (STEL) with all conduit, wire, outlets, and equipment as shown on the drawings.

B. SYSTEM OPERATION

1. The Carehawk / Dukane CH1000 is a Life Safety Communications System, multichannel, microprocessor-controlled communications system. The system is capable of distribution using Administration telephones (DA1s), IP telephones, standard DTMF telephones (STELs), Caller ID Telephones (CTCLs), loudspeakers, and other devices as described herein. The system central equipment shall be capable of receiving 2048 call-ins simultaneously without data collisions or loss of any call-ins. Call-ins shall remain in the system queue until answered. Emergency Call-ins shall automatically move to the top of the call-in queue and sound in the in-use telephone earpiece to notify the user of an emergency call. The system shall provide two independent intercom channels between any telephone and loudspeakers. Two additional, simultaneously operating channels shall be provided for distribution of program material. Systems not providing multiple, simultaneous speech paths/voice channels shall be unacceptable.

- a. The system shall provide user-programmable room number assignment.
- b. The system shall provide 3-, 4-, 5- or 6-digit alphanumeric format for architectural room numbering and 60 character alphanumeric call ID description associated with each audio port.
- c. The dialing sequence shall incorporate full numeric capabilities as available on industry-standard telephone key pad.
- d. The DA1 and CTCL shall allow the user to view the numeric room address of the calling station and the type of call (e.g., emergency, normal). The DA1 shall use distinctive ringing patterns to annunciate the type of call. The CTCL shall be capable of being programmed to visually

annunciate the call type. It shall be possible for some CTEs to display the date and time.

- e. When a CTE is employed as part of the CH1000 System:
 - f. Emergency and normal call-ins and telephone calls shall be routed to the VoIP Telephone Module (VTM) or the Central Control Card (CC200) for processing and shall be sorted in order of priority as well as time of call placed.
 - g. The CTE shall be used to view call-ins, access the system, and perform many of the functions available from the DA1 at a touch of a button. Some of these functions are emergency paging, tone distribution, music distribution, and intercom.
 - h. Calls from STEs or intercom call-ins shall display in the same manner.
 - i. CTEs shall allow the user to respond to the call and view call information for both telephone and intercom calls. Calls from call-in devices shall be capable of being programmed to call into CTEs. These phones shall ring when called.
 - j. The base system shall support eight FXS Caller-ID enabled telephone ports. FXS ports shall be used to interface with system Administrative phones, standard telephones, and PBX/KSU/.iPBX/VoIP telephone systems. The system shall have the capability to add additional ports in groups of 16 or 32 Administration or standard telephones and any number of IP telephones.
 - k. The system shall allow future expansion of the program channels to a total of two individual channels.
 - l. The system shall be compatible with industry-standard 2500 DTMF telephone instruments with electronic ringers (STEs) and CTEs.
 - m. The system shall not require an Administrative console to operate. All system functions shall be accessible via telephone codes from any internal and/or external telephone.
 - n. The system shall be capable of providing individual control of inputs from and outputs to external devices.
2. Rooms shall be equipped with programmable call-in buttons, STE handsets or IP telephones. Call-ins can additionally be initiated by operation of a personal wireless transmitter, Vcall PC base call button or security sensor. Call-ins from buttons shall be programmed to a minimum of seven priority levels. Upon arrival at the designated DA1 or CTE, the call shall be visually displayed and audibly annunciated. Audible and visual annunciation shall also be received at a remote display unit (RDU) if the system is so equipped. The system shall be capable of accepting up to three call-in devices, each with different priorities.
3. The system shall have the capability for modular capacities of 2048 audio ports including speakers and Call in buttons. The system shall support any number of DA1s, CTEs, STEs, IP telephones, Inputs, and outputs.
- a. All port locations shall be assigned to a 3-, 4-, 5- or 6-digit full numeric/alphanumeric dial number as available on industry-standard telephone key pad.
 - b. Systems that are not modular or expandable or require replacement of any previously installed equipment shall not be acceptable.
 - c. The system shall support a minimum of 8 trunk ports.

4. Provide, if desired by Owner, a unique pre-announce tone to sound prior to the normal class change signal or as desired for unique events. These tones are WAV files and can be adjusted for level and duration, as desired.
 - a. The system shall provide for a minimum of 25 distinct WAV file system tones and 25 custom WAV files, each of which shall be programmed from a selection of tone types.
 - b. The following programmable system tone events shall be available:
 - a. *Emergency page pre-announce*
 - b. *Civil emergency*
 - c. *Auxiliary alarm*
 - d. *Emergency reminder tone*
 - e. *Page pre-announce*
 - f. *Normal reminder tone*
 - g. *Custodial tone*
 - h. *Door tone*
 - i. *Intercom pre-announce*
 - j. *Privacy tone*
5. The system shall provide up to two simultaneously operating, non-restrictive, multiple input source, program distribution channels. This functionality shall be programmed and distributed from DA1s, CTEs, STEs or IP telephones. The system shall provide restriction of programming channels from all or certain designated telephones. Systems that require manually operated switchbanks shall not be acceptable.
6. The system shall have user-assignable groups of stations for zoned audio paging, class change signals, or program distribution, with any station belonging to all zones, some zones, or no zone.
 - a. Paging shall originate from any DA1, CTE, STE, PBX, IP telephone, dedicated paging microphone, or program source input.
 - b. The system shall allow a telephone to be associated directly with a loudspeaker by assigning them the same dial number.
 - c. The system shall include page or intercom priority over class change tones and preprogrammed events. Class change tones occurring simultaneously with an all page or zone page shall be programmable to be delayed until the active page has concluded.
 - d. The system shall use the industry-standard 25-volt method of transmission. Systems using non-standard methods such as 45-ohm loudspeakers without line matching transformers shall not be acceptable.
 - e. The system shall allow each loudspeaker to be a member of up to 64 zones.
 - f. Communications with each classroom loudspeaker shall be hands-free. The staff member or occupant in the classroom need not operate any buttons to reply to a call. The DA1 operator shall use the hands free option or handset on the DA1.
 - g. A mute button shall be provided on the DA1 to allow the operator to mute the outgoing conversation as desired.

7. All audio functions in the system shall operate within the following priority scheme:
- a. A lower priority function shall not interrupt a higher priority event.
 - b. A lower priority event shall be interrupted by a higher priority event.
 - c. Interrupted lower priority functions (automatic) shall be restored after conclusion of the higher priority function. If an event is initiated while a page is occurring, the event shall be optionally delayed until the page is complete.
 - d. Telephone conversations shall not be interrupted by the above listed functions.
 - e. The following priorities are ranked from highest to lowest;
 - a. Emergency intercom
 - b. Emergency page
 - c. Civil emergency
 - d. Manual time tone and high priority event tone
 - e. All call and zone page
 - f. Intercom
 - g. Custodial tone
 - h. Low priority event tone
 - i. Program distribution
8. In rooms provided with a privacy switch, the system shall incorporate all necessary circuitry to prevent overhearing conversations in any room equipped with a loudspeaker. The DA1 shall provide the user with an indication that the classroom privacy switch is in the privacy mode.
9. The system shall distinguish between an emergency call and a normal call from any station, and automatically route each type of call-in to a different DA1, CTEL, STEL or IP telephone.
- a. The system shall also include provisions to allow call-in coverage to be redirected to an assigned coverage group manually, or if the call-in is not answered within a user-defined period of time.
10. Each call-in switch shall be programmable or assignable to one of seven priority levels and up to 32 distinct call-in destination groups. The seven priority levels shall be as follows:
- a. Priorities shall be assignable to any one of three levels of emergency calls:
 - a. *Emergency-1 (E1)*
 - b. *Emergency-2 (E2)*
 - c. *Emergency-3 (E3)*
 - b. Priorities shall be assignable to any one of three levels of normal calls. A normal call shall be remotely upgraded to an emergency call (E1) by pressing the call button twice.
 - a. *High priority (HP)*
 - b. *Normal priority (NP)*
 - c. *Low priority (LP)*
11. Normal and emergency priority levels shall provide a distinctive call-in ring with a programmable cadence.

12. Calls routed to the appropriate DA1, CTEL, STEL or IP telephone destination group's call-in queue shall be placed in the order of priority and time of origination. When a call-in occurs to a specific call destination group, the call-in shall ring at all DA1s, CTEls, STEls and IP telephone in the assigned group. Any telephone within the group shall be able to answer the call. Telephones not within the call group can also answer using a dial code. When a call-in is not answered within a user-designated programmable time and the call-in shall be re-directed to other call groups. The call-in then shall be answered at any DA1, CTEL, STEL or IP telephone by dial code.
13. Calls routed to the DA1 shall display the incoming caller's room number and caller-ID information along with the total number of calls within the call-in queue. Calls can be scrolled by the DA1 using the "Down" key or the "UP" key for selective answering of intercom calls. If the DA1's queue has a high priority or emergency call-in present (Priorities E1-E3), a calling telephone shall receive a busy signal. Emergency calls received at the DA1 shall cause the calling station identification number to be accented in the display. Normal calls shall be displayed steadily.
14. When a system port is dialed from the DA1, the dialed number shall appear in the DA1 display window. Ring back or tones from the DA1 shall indicate the mode of operation currently activated.
15. Calls routed to the CTEL shall display the incoming caller's room number and caller-ID information after first ring cadence. Normal and emergency calls received at the CTEL shall be displayed steadily. Depending upon the type of CTEL employed, the date and time of call shall also be displayed. A Type 2 CTEL already off-hook during second pending call, shall display pending call after a call waiting signal.
16. When a system port is dialed from the CTEL, the dialed number shall appear in the CTEL display window. Ring back or tones from the CTEL shall indicate the mode of operation currently activated.
17. DA1, CTEL, STEL and IP telephone calls to other telephones shall ring the appropriate telephone and be connected when the called party goes off-hook.

18. The system shall allow any system telephone to be programmed to place an off-hook duress call-in to any destination groups. Duress call: A preprogrammed destination group and priority level can be programmed to occur after a preprogrammed off-hook time limit.
19. The system shall allow any telephone to place an emergency voice paging announcement. (This can be restricted to individual telephones through page access restrictions.)
20. The STEL shall also be used to initiate a tone, WAV file or a local program to rooms, zones, or all rooms.
21. The STEL shall be configurable to initiate a normal or emergency priority level voice page to zones, or intercom to a speaker, or dial another telephone automatically when off-hook.
22. The system shall provide the capability for a loudspeaker station, handset, and zero to three call-in devices at each remote location or classroom.
 - a. When an STEL is located in the classroom, the user shall have the ability to toggle back and forth between conversing on the telephone or the speaker station.
 - b. If a call is placed to a classroom loudspeaker, the call is automatically transferred to the handset when the handset is lifted. This is a user-programmable option on a telephone by telephone basis.
 - c. In a room equipped with a loudspeaker, if the handset is off-hook and a call is placed to that room via the loudspeaker, the caller's voice shall be automatically received in the room. This allows the caller to contact an individual room and carry on two-way communications even though the telephone is off-hook. Two separate and distinct voice paths are available to each classroom.
 - d. Call-in devices shall consist of single or multiple switch assemblies, with or without privacy switch capabilities, and with or without call assurance LED capabilities.
23. The system shall allow any telephone to be programmed to allow or exclude initiation of all call, zone page, or emergency announcements.
 - a. The system shall allow any preprogrammed telephone parameter to be circumvented through the use of a pre-assigned account code. Upon hanging up, the telephone returns to its previously programmed state. Up to 256 account codes are available allowing for staff and administrative programming override. Account codes shall be controlled by both day and night Class of Service in addition to 8 different Event Class of Service Groups.
 - b. The system shall support a minimum of 64 different Class of Service parameters with each extension having both day and night class Class of Service. The following attributes are programmable and available for each Class of Service:
 - a. Dial access
 - b. Telephone ring access
 - c. Direct off-hook call-in answer
 - d. Timed off-hook duress call-in
 - e. Page access
 - f. Tone access
 - g. Program access
 - h. Intercom access

- i. Room exclusion access
 - j. Output control access
 - k. Forward access
 - l. Administrative access
 - m. Digit 9 access
 - n. Digit 8x access
 - o. Direct off-hook intercom speaker-to-handset transfer
 - p. Emergency ring access
 - q. Normal ring access
 - r. Direct off-hook page or telephone call
 - s. Direct off-hook intercom answer
24. The DA1s, CTCLs, STELS and IP telephones shall be capable of, but not restricted to, the following:
- a. Two simultaneous, three-party conference circuits
 - b. Extension-to-extension direct dialing
 - c. Extension-to-speaker station direct dialing
 - d. Call on hold
 - e. Call transfer
 - f. Paging
 - g. Tone distribution
 - h. Preprogrammed speed dialing
 - i. Call forwarding
 - j. Interface with electronic key system and/or PBX
25. A group of loudspeakers shall be temporarily excluded from receiving time, non-emergency page, or program distribution by designating the desired stations as excluded stations from a preprogrammed zone.
- a. Using the Dukane / Carehawk Assistant Software, individual rooms desiring exclusion on a temporary basis, (e.g., student testing purposes or quiet times) shall be able to exclude themselves for the day. The initiator can cancel this exclusion at any time. A temporary exclusion shall programmed with the Dukane / Carehawk Calendar Software to automatically return to the preprogrammed station status before the start of class the next day.
 - b. The system shall allow that a group of loudspeakers be permanently excluded.
26. The system shall contain a flexible database capable of addressing each system telephone and assigning unique parameters to each phone.
- a. Each classroom telephone shall be capable of being associated (for answer purposes) with specific administrative telephones. This association can be automatically changed dependent upon time of day.
 - b. Each classroom telephone shall be assigned an architectural or ID number to communicate with its assigned administrative telephone. This coverage shall allow preselected coverage of call-ins from classroom telephones to administrative telephones, on a station-by-station or room-by-room basis.
 - c. Call-ins to administrative telephones shall be programmed to call groups of administrative telephones.

27. The system shall contain an integral master clock and programmer capable of performing the following functions:
- a. Provide unlimited discrete time event entries for programming functions based upon:
 - a. The time of day in hours and minutes
 - b. The day or combination of seven days of the week on which the event is to occur
 - c. The selection of any one or any combination of 64 zones or five internal outputs to be activated
 - d. The selection of any schedule to allow for maximum flexibility due to special circumstances or seasonal changes
 - e. The selection of 25 user-programmable event tones plus 25 WAV files.
 - b. Provide for automatic daylight saving time adjustment with leap year programming.
 - c. Provide momentary contact closures for external device operation. Provide six inputs, five outputs, and two flex-puts.
 - a. Inputs shall be programmable by the installer/system administrator to initiate any desired system activity (e.g., tone, program, events).
 - b. Outputs shall be programmable by the installer/system administrator to activate during any desired system activity (e.g., page, tone, program, time of day).
 - d. Display the time of day in either 12 or 24 hour format at each administrative telephone.
 - e. The master clock shall interface with an existing master clock to allow the two systems to synchronize.
 - f. The master clock shall correct compatible secondary clocks, analog or digital or both.
 - g. The system shall provide for an editing and review routine to permit the user to change and edit time events, zones, and schedules.
 - h. The system shall allow preselected program material to be distributed according to preprogrammed schedules (i.e., march to music, national anthem.)
28. The system shall include facilities to allow automatic control of external devices, (e.g., cameras.) The system shall provide multiple outputs designed to interface with external devices. A total of 133 outputs shall be provided. Outputs to activate/deactivate remote door locks or operate cameras shall be activated manually from an DA1, CTEL, STEL or IP telephone. Refer to the section covering input and output control for additional capabilities.
29. The system Central Control Card (CC200) shall contain a minimum of 1 Gigabytes of removable/upgradable flash storage and 512 Megabytes of RAM. Minimum processor speed shall be 500 MHz to efficiently process the time critical events generated by the CH1000 communications platform. The processor shall control all functions and features of the built-in self-diagnostics and continually monitor the system's integrity. All system programs and changes shall be permanently stored on the Central Control Card (CC200). It shall be possible to review and reload any program or change that was loaded on the system regardless of age. The system shall be provided with a user-friendly PC interface, Windows® based, for system programming and

diagnostics. User or service technicians shall send or receive complete system configuration data, using system software packages. All system programming shall be stored on the Central Control Card (CC200). The system shall allow this information to be reloaded at any time either on-site or from a remote location. The software shall support remote (off-site) diagnostics and system programming through an Ethernet connection.

30. The system shall filter all voice signals through a Digital Signal Processor (DSP) to maximize voice intelligibility.

C. ADMINISTRATIVE TELEPHONE (DA1)

1. The DA1 shall be desk or wall mounted and contain a matching telephone handset with retractable coiled cord and conductive rubber button switches, with clearly designated touch points. The housing shall be constructed of high impact, flame retardant, black plastic. Dimensions shall be 9-1/2" (23.75 cm) wide by 4-1/2" (11.25 cm) high and 8-3/4" (21.9 cm) deep. Dimensions include handset. Weight shall be 4 lb. (1.8 kg). Terminations shall be a RJ-45 modular telephone type jack. Features shall include:
 - a. Plastic moisture-sealed buttons
 - b. Large, easy-to-read, 8 line by 20 character back lit display
 - c. Menu-driven display for ease-of-operation
 - d. Handset or speakerphone
 - e. Alphanumeric 3-, 4-, 5- or 6-digit dialing
 - f. Distinctive electronic ring signals
 - g. 200 speed dials
 - h. Wizard driven menu system
 - i. User-programmable function keys
 - j. Telephone-type modular connector
 - k. Sensitive loudspeaker
 - l. Built-in condenser microphone
 - m. Queuing
 - n. Telephone-style handset with dynamic receiver and electret transmitter
 - o. Head set compatible

D. EQUIPMENT ENCLOSURES: The Intercom Program Equipment shall be wall mounted. The overall equipment cabinet dimensions shall not exceed 18 1/2 "H x 17"W x 5-3/8"D. Color shall be black. All intercom system / program equipment shall be provided as required to fully implement a functioning system. The equipment enclosure will include the Central Control Card, Main Interface Card, Power Supply Module, Intercom Modules, Telephone Communication Modules and Digital Amplifier.

1. The system shall be mounted on 3/4" plywood backboard (painted)
2. The program sources shall be remotely located from the control equipment. The program rack shall be a black metal finish, tabletop rack located at the reception area. Do not provide wood finish cabinet.
3. Provide CAT5 connections for 8 telephone ports and 8 local or remote Switching Security Modules (SS16/32).
4. Provide wall mounted remote Security Switching Modules as required mounted in IDF Rooms.

INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

- E. SPEAKERS, CEILING MOUNTED: Shall be 8" full range loudspeaker baffle combination. 5 oz. nominal magnet eight, 10 watt continuous power, with matching dual 25/70 volt transformer. Transformer shall be capable of delivering at least 5 separate wattage taps from 1/4 watt to 4 watts. Flush mounted onto steel back box. Provide Dukane / Carehawk 6A634 or approved equal. Provide Dukane / Carehawk 145-226 enclosure system and Dukane / Carehawk 677-67 speaker supports for each speaker. All speakers in the following room types shall have volume control on the speaker to allow for adjustments: Classrooms, Admin, Reception, Conference Rooms, Kitchen and staff work areas
- F. Cafetorium, General Purpose Rooms etc. with architectural lay-in ceilings 12 feet above finished floor or greater shall have 8" speaker with 5 oz. magnet complete with line matching transformer. Program rating shall be 12 watts continuous. The speaker shall be Soundolier FD72W or approved equal. Provide Soundolier CS95-8 enclosure system and 81-8R speaker supports for each speaker. 25/75 volt transformers shall have primary taps of 1/2, 1, 2, 4 watts.
- G. CLOCKS: Non-IP, 12 inches 24 VAC synchronous analog clocks for elementary schools or 4 inch, LED digital for high schools. Provide Dukane / Carehawk as shown on plans. Provide backboxes, wiring, and raceway as required for proper operation. Provide wire guards in cafeteria/gym.
- H. WALL MOUNTED SPEAKERS: 8 inches full range speakers with dual 25/70 volt transformer shall mount in flush square speaker baffles as shown on the plans. Soundolier C5A speaker with LT72 transformer 161-8 square baffle, and 198-8 flush square enclosure. If speaker must be surface mounted, provide SE175-4 enclosure.
- I. Outdoor paging speakers shall be on a separate zone from interior speakers. Each individual room such as a classroom, office, conference room, or gymnasium shall be a circuit.
- J. WALL MOUNTED VOLUME CONTROL Provide as shown on floor plans. Provide Soundolier AT-10 or approved equal recessed autotransformer volume control. Routine paging shall not override the volume control.
- K. OUTDOOR WEATHERPROOF PAGING / PROGRAM SPEAKERS: Shall be UL listed, flush mounted water proof type paging speakers for voice and tones with matching transformer. Quantity as shown on plans. Provide Soundolier APF-15T With 193-8-6 Back box and VP161-APF Baffle. Back boxes shall be recessed to allow horn to be flush mounted with wall.
- L. AM - FM ANTENNA: Provide a complete AM/FM antenna system, as required for proper radio reception. Provide a weather headed conduit run from roof to intercom junction box if required. Provide all mounting and connection hardware to receive available off air channels. Feed from building cable system, provided under separate section is an acceptable signal source. Installation shall be in accordance with latest safety standards. All mastings and outdoor mountings shall be capable of with standing winds of up to 100 MPH. Provide lightning protection and grounding as per National Electrical Codes. To minimize likelihood of a lightning strike, contractor shall mount the antenna so that its upper tip is below the metal flashing at the edge of the roof.
- M. SURGE PROTECTOR / UPS: Provide a Minuteman, rack mounted EnterprisePlus Line Interactive Uninterruptible Power Supply, Model #E1500RM2U

INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

N. Program Source

1. 1 qty. AtlasIED AP-S15A power conditioner and distribution unit
2. 1 qty. JBL CSM 28 Line Mixer
 - a. Provide machine printed label on front of device for each input / output indicating function,
3. 1 qty. Tascam CD-400U media player
4. 1 qty. Proco iRack iPod input panel
 - a. 1 qty. Whirlwind MST-06, 6' 3.5mm cable
5. 1 qty. 6RU, black table-top enclosure for all equipment.
6. 1 qty. custom 1RU panel with 4 push buttons to activate 4 distinct tones
 - a. Coordinate tones and tone function with Owner
 - b. Provide machine printed label for each button indicating function
7. Provide Astatic 878HL-2 desktop PTT microphone.
 - a. Provide 1 qty. 10' XLR cable, black; Whirlwind MKQ or approved equal.

2.2 ADDITIONAL EQUIPMENT

- A. Contractor shall include in their pricing, the cost to furnish and install the following additional equipment. These devices shall be used to fulfill any changes request issued until the list is depleted. Upon the completion of the project, all remaining material shall be delivered to the project for owner stock. No devices shall be used without documentation and written authorization from the project's technology consultant. Contractor shall obtain a signed transmittal of additional equipment to the owner at the end of the project. The signed transmittal shall be included in the contractors closeout documents.
- B. Additional Equipment List:
1. (15) Ceiling Mounted Speakers with tile bridges
 2. (15) Wall Mounted Volume Controls
 3. (2) Administrative Call Stations
 4. (5) Exterior Speakers
 5. Provide (1) concealed remote button to activate lockdown tone while simultaneously calling 911.

PART 3 – EXECUTION:

3.1 MATERIALS:

- A. WIRE: Wire between the main equipment cabinet and local or remote Security Switching Modules shall be CAT5 with wire distances not exceeding 2700 feet. Cable for speakers, call-in switches, and security inputs shall be #22 gauge at a minimum or as recommended by the manufacturer under plenum jacket. No splices are permitted except in approved junction boxes. All terminations shall be made on telephone type punch blocks or at specified devices. Display, speaker, and specialty cables shall be as required for best operation under manufacturer recommendations.
- B. JACKS: All station device terminations (except speakers) shall be terminated on USOC standard modular jacks. Jacks for wall mounted telephones shall have lugs for securely attaching the instrument to the wall.

- C. BACKBOARDS: Provide 4 feet x 4 feet plywood backboards for mounting of system cross connects. Mount as shown on the plans. Provide Modular Termination backboards with 66 type terminal blocks as required to terminate all cables. Provide Distribution and cross connect backboards equal to AT&T 66 Series for all cross connect wiring.
- D. Cabling between the Security Switching Modules and the terminal blocks shall be provided with telephone type 50 pin connectors to allow ease in console connections, disconnection's and service. SDA1lite terminal junction boxes shall be provided as needed to allow for station terminations in each building.

3.2 INSTALLATION:

- A. All work under this section shall be performed by persons having specific familiarity with telephone, data and sound system installation. Upon request the contractor shall submit resumes, references or other corroborating documentation, to the engineer to confirm the contractors capabilities and experience.
- B. GROUNDING: Except were specifically indicated otherwise, all exposed non-current carrying metallic parts of the communications system shall be grounded. This may be accomplished via a driven ground rod, cold water pipe or building power ground. If the building power ground is used, a separate ground conductor shall be used from the equipment to the grounding grid. All grounding shall be done with #6 solid copper wire or larger. The contractor shall use every effort to insure system stability and safety.
- C. WIRING: A comprehensive, documented communications wiring system is to be installed. Wiring is to be identified by room number, segregated, neatly laced, and terminated on telephone type punch blocks. Back boards and cross connect fields shall be neatly organized as to function. (ie: intercom, telephone stations, data network etc.) All termination points are to be labeled with function. Data cables shall be certified as usable and checked using the cable certification sheet. Data cables shall be labeled as per the data identification scheme.
- D. SPEAKER WATTAGE TAPS: Tap Corridor Speakers for 1 watt, Outside Horns 7.5 watts, Tap Speakers in High Ceilings (15FT +) at 4 watts. Rest rooms ½ watt.
- E. All communication wires and cables installed above ceiling shall be identified and tagged at each end. The identification shall include the room number one markers similar to T&B sleeve marker.
- F. Provide integration with clock and bell system
- G. Provide integration of local sound reinforcement system override.
- H. Mount all handsets on 2-gang electrical boxes at 42" a.f.f. unless noted otherwise.
- I. Mount outdoor paging speaker in flush mounted box with 15 watt power rating and with built-in matching transformer. Attach firmly to building and provide water tight fit.
- J. Provide for future portable buildings. Provide 12 circuits minimum, pulled and punched down on terminal block above the ceiling at the exterior wall where portables will be located.
- K. All headend equipment and wiring shall be provided and installed for future circuits on initial

installation.

- L. Speakers in very small or very reflective rooms (ex. Restrooms) shall be tapped at ¼ watt.
- M. All communication wiring between the main equipment cabinet and the Security Switching Modules shall be CAT5. Wiring to speakers, call-in switches and security inputs shall be 22 AWG, Type TW and all audio signal wiring shall be # 16 except where indicated otherwise or as required by article 800 of NFPA 70 (NEC).
- N. Final system room designations shall be based on actual room number graphics (Do not use the construction plan Architectural room number designations).

3.3 CABLE PATHWAYS

A. Cable Support:

- 1. All wire not installed inside conduit shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
- 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the support hook to the treaded rod.
- 3. cable support shall be installed at a maximum of 5' on center.
- 4. All cable installed shall be attached to the support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed to be used inside the fire alarm panels as required to manage the wires within each type of panel.
- 5. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
- 6. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.**

B. Conduit / Raceway:

- 1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- 2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC, local, and state requirements.
- 3. Minimum conduit size shall be 3/4" (19.1 mm). Install conduit per engineered shop drawings.
- 4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

3.4 TESTING AND ACCEPTANCE

- A. General
 - 1. After completion of installation and start up procedures, commence a verification and testing sequence leading to final acceptance of the owner.
 - 2. Submit for approval, a sample of the form on which the test will be reported.
 - a. Identify project
 - b. Signatures of participants and observers
 - c. Results
 - d. Description of adjustment or corrections of defective components.
 - e. Date
 - 3. Provide schedule of tests. Estimate dates of significant events.
 - f. All testing shall be performed in the presence of the Owner/Architect/Engineer.
 - 4. Test, calibrate and adjust each device in the system
 - 5. Verify operation of all specified functions.
 - 6. Provide documentation of all tests and verifications as specified.
- B. The following tests and adjustments shall be performed by the Contractor. All equipment required supplied by the Contractor. Follow EIA standards RS-160 and RS-219 in performing tests. Make all necessary corrections to bring systems into specification compliance. Record the results of these tests in project record drawings. Submit written results of tests to Architect prior to scheduled equalization and final inspection date.
 - 1. Measure and record impedance of each speaker line terminating at equipment racks at frequency of 1,000 Hz. with loud speakers connected to their respective lines.
 - 2. Check system to ensure freedom from oscillations or stray RF pickup. Check inputs with no signal and with typical program material driving system to full output. Detect unwanted signals.

3.5 INSTRUCTIONS

- A. Provide 4 hours of instruction in two 2-hour blocks or four 1-hour blocks to the Owner designated user and maintenance personnel on the use and operation of the system. Instructing personnel shall be a competent engineer or technician familiar with the installed system. Instruction times shall be arranged by the Owner.

3.6 ACCEPTANCE BY OWNER

- A. Upon completion of initial tests and delivery of all documents, diagrams, and project record drawings, notify the Architect in writing that the installation has been completed in accordance with the requirements of the specification and is ready for equalization and inspection by representatives of the Owner.
- B. Acceptance testing will include operation by the Owner of each major system and other components (microphones, consoles, racks, loud speakers, etc.) deemed necessary. Contractor will assist as necessary in this testing.
- C. In the event the need for further adjustments or work becomes evident during acceptance testing, the Contractor will continue his work until the system is acceptable, at no additional cost to the Owner.

3.7 TESTING AND TRAINING:

- A. Prior to connection of any terminal equipment all cables shall be tested as per REA spec. PC-4. Cables shall be tested for Opens, Splits, Crossed Pairs, Shorts to Ground and Shield Continuity. All defective cabling is to be replaced prior to device hook-up.
- B. Upon completion of the installation the contractor shall test each room station speaker, handset or call switch for proper operation. All telephones, programming and functions are to be tested for proper operation. All emergency and program functions are to be tested. Any malfunction shall be corrected prior to final acceptance.
- C. A minimum of Four hours time shall be included in the bid for instruction of the owners forces in proper operation and routine maintenance of the system. Instruction shall cover all materials indicated in the owners and operations manual.
- D. Operational guidelines shall be given in written form in sufficient numbers so that all key personal have operational instructions of programming, station use and special features. Copies of these instructions shall be provided for permanent record in the operations and maintenance manuals specified above.

END OF SECTION

SECTION 27 51 23.80 – LOCAL SOUND REINFORCING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. Provide all materials, equipment, transportation, and labor to achieve complete and fully functional systems as shown or intended on drawings and in bid specifications.
- B. All applicable equipment shall bear the UL label. All work shall be executed in accordance with the National Electric Code (NEC), the Occupational Safety and Health Act (OSHA) and all applicable State and Local codes, ordinances, and regulations.
- C. The Contractor's installation team shall have at least one member possessing a NICET Level II, CTS-I or C-EST certification; additionally, at least one audio DSP programmer certified in HiQnet Audio Architect, Symetrix, Biamp Tisera, QSC Q-SYS or Dante.
- D. Contractor shall have been in the commercial AVL (Audio, Video, Lighting) installation industry for at least five years. Contractor shall have installed at least five systems of this type and comparable scale in educational facilities within the State of Texas. Contractor shall provide a list of successfully completed projects including completion dates within the past two years from the bid date of this project.
- E. Should the local sound systems include Crestron or AMX hardware which requires programming, the Contractor shall provide a Certified Crestron Programmer or an AMX Certified Expert (ACE) Programmer to program, upload and debug the third-party control systems.
- F. Should the local sound systems include managed network devices, the Contractor shall provide one person on the installation team with valid certification in one of the following: Harman HCNA/P, CompTIA Network+, Cisco CCNA or Cisco CCNP. Provide valid certification credentials in the submittal documentation.
- G. Any discrepancy in quantity or part numbers between the drawings and the bid specifications shall be brought to the attention of the Consultant for clarification during the bidding period. No allowance shall be made to the Contractor by reason of failure to have brought said discrepancies to the attention of the Consultant prior to award of contract. Should discrepancies be discovered, the greater in quality and quantity shown shall be provided.
- H. Systems to be installed but not limited to in the following areas per Part 2:
 - 1. Gymnasium C152

1.2 REGULATORY REQUIREMENTS

- B. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
 - 1. Latest Local Codes and Amendments
 - 2. 2015 National Electrical Code

C. Other References:

1. TIA/EIA-568-A – Commercial Building Telecommunications Wiring Standard
2. EIA/TIA-569 – Commercial Building Standard for Telecommunication Pathways and Spaces.
3. TIA/EIA-606 – The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
4. TIA/EIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
5. EIA/TIA 455-A – Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices and Other Fiber Optic Components.
6. TIA/EIA TSB 67 – Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
7. TIA/EIA TSB 72 – Centralized Optical Fiber Cabling Guidelines
8. ISO/IEC 1180 – Generic Cabling Standard
9. EN 50173 – Generic Cabling Standards for Customer Premises
10. ANSI/EIA/TIA 526-14 – Optical Power Loss Measurements of Installed Multimode Fiber Cable Plan.

D. Governing Codes and Conflicts:

1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.3 ABBREVIATIONS

- A. The following abbreviations are used in this document:

1.4 SUBMITTAL DOCUMENTATION

- A. Submit shop drawings as specified in pdf format, ARCH E1 (30x42). Contractor shall be responsible for costs associated with producing and submitting all required documentation.
- B. Submit a room-by-room list of all equipment to be installed, in pdf format.
- C. Submit Manufacturer's product data for all equipment with a table of contents, in pdf format.
- D. Submit a line-item compliance statement indicating that the products being submitted comply with the specified equipment and indicate which products deviate from the specifications.
- E. Submit detailed drawings of all systems, minimum scale 1/8" = 1', in pdf format.
1. Table of Contents.
 2. Rigging details. All hardware must meet or exceed a safety factor of 5:1. Detail the product manufacturer, part numbers and load capacity of all hardware to be used. **Contractor shall employ the services of a professional structural engineer licensed to practice in the State of Texas to verify load ratings of hanging components. Provide attachment details on Shop / Submittal Drawings reviewed by said engineer. Include stamped report of items reviewed by structural engineer with shop drawings submittal. Report shall**

include an itemization of items reviewed by the structural engineer and confirmation that proposed methods of suspending equipment as shown on the shop drawings conform with required safety factors.

3. Floor Plans, Reflected Ceiling Plans and Section Elevations displaying loudspeaker locations and orientation, wall plate locations, rack locations, 120vAC receptacle locations and all other related device locations.
4. Comprehensive system schematics displaying detailed connections to all equipment. These shall display wire numbers, terminal block numbers, patch bay assignments and color coding.
5. Proposed construction details for any custom fabricated items; including interface panels, patch panels and wall plates. These shall display dimensions, materials, finishes, I/O connector labels and color selection.
6. Rack elevations displaying the locations of all equipment within each rack.
7. Riser diagrams displaying conduit requirements with pull boxes, outlet boxes, cable layouts, cable type part numbers and quantity of cables with part number in each conduit.
8. Electrical power requirements for the systems. Include diagrams for any remote control of electrical power displaying locations and elevations for all receptacles in detail sufficient to coordinate with the Electrical Contractor.
9. All submittal drawings not meeting the above criteria shall be deemed incomplete, shall not be reviewed and shall be returned for revision.

1.5 OPERATING AND MAINTENANCE MANUALS

- A. Provide Operating and Maintenance Manuals as specified in Division 26 and Division One and deliver to the Owner.
- B. Include:
 1. Product Data.
 - a. Manufacturer's data for each type of product conforming to the submission format specified herein. Include manufacturer's serial numbers within the list of product.
 - b. For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
 - c. Each product's Owner Instruction Manual. Provide high quality copies where necessary, with all text legible and illustrations of equal resolution and sharpness as the original manual. Faxed copies or copies with portions of the information missing or smeared are not acceptable.
 - d. Manufacturer's maintenance and care instructions.
 - e. Separately bound list by manufacturer and model or part number of product incorporated within the systems arranged in alphanumeric order.
Manufacturer's warranty statements bound separately where applicable.
 2. A complete as-installed (As Built) equipment list, listed by room, identifying manufacturers' names, model numbers, serial numbers, quantities and locations of each item.
 3. Complete and correct As Built systems schematics, floor plans, reflected ceiling plans, elevations, rack risers and I/O plate details. Include diagrams or charts displaying final settings of all control knobs in the system (mixers, equalizers, audio amplifiers, etc.).
 4. Each individual system's program software / source code (audio, video, lighting and third party control) with final settings and pass codes and As Built AutoCAD files (2013 or newer) shall be saved onto two separate 8GB thumb drives and included in the close-out documentation. All software programs / source codes are the intellectual property of the Owner.

5. Quick-start Guide for each system written with the assumption that the intended reader is technically inexperienced and unfamiliar with the facility. The Quick-start Guide shall be laminated and affixed to the inside of the front door of the system rack with appropriate mounting hardware. One copy of each individual system schematics printed in ARCH D (24x36) and laminated shall be delivered to the Owner.
6. Two hard copy, paper sets of the as-installed (As Built) drawings in ARCH E1. Drawing sets shall be individually bound.
7. In addition to the hard copy close-out documentation, all close-out documentation shall be included, in pdf format, on the, 8GB thumb drives.
8. Service & Maintenance Manual:
 - a. Provide an original manufacturer's copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. On equipment where there is no service manual, provide statement from company indicating manual is not available. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer's maintenance and care instructions.
 - c. Maintenance Instructions, including maintenance phone numbers and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
9. Organize documents into separate bindings containing data relevant to operation, maintenance, and warranty.

1.6 WARRANTY AND SERVICE

- A. The Contractor shall warrant all new equipment to be free of defects in materials and workmanship for not less than one year after the Substantial Completion date.
- B. The systems are to be free of defects and deficiencies and are to conform to the drawings and specifications as to kind, quality, function, and characteristics. The Contractor shall repair or replace defects which may occur in labor or materials within the warranty period without charge to the Owner.
- C. Within the warranty period, respond to requests for service within 24 hours. Service calls to perform warranty work shall be made within 72 hours of request by the Owner. Temporary, equivalent replacement equipment shall be provided at no cost to the Owner when immediate on-site repairs cannot be made.
- D. This warranty shall not void or replace individual manufacturer warranties which extend past this warranty period. This warranty shall not void any rights guaranteed the Owner by law.
- E. The Contractor shall include in the close-out documentation a certificate of warranty which includes the start and end dates of the warranty and contact information, including name, telephone number and email, of individuals to perform warranty service.
- F. This warranty shall not apply to existing Owner Furnished Equipment.
- G. Additional warranties may be negotiated between the Contractor and the Owner at the Owner's discretion.

1.7 SUMMARY OF WORK

- A. The installation shall comply with all applicable codes and standards in effect at the job site and as indicated in the Drawings and Specifications.

1. Reference project drawings for locations, quantities, and coordination with other trades.
- B. All local sound racks shall have cabling installed and routed according to industry standard best practices. Contractor shall employ horizontal lacing rails in the rear of the rack for neat and orderly cable routing. Use Velcro strips for cable bundling. ZIP TIES ARE NOT ACCEPTABLE.
- C. Contractor shall perform an RF scan and shall provide results in pdf format with the close-out documentation. Contractor shall provide an RF coordination sheet, documenting all RF frequencies in use in each system, including in the High School buildings, to ensure there is no RF interference between systems. Coordinate with General Contractor and for access to High School building systems.
- D. Contractor shall tune each system's DSP to provide a flat frequency response.
 1. Tune and set dynamics on all inputs to provide the highest level of gain before feedback while providing intelligibility of all inputs.
 2. Contractor shall perform a "rattle test" of all systems: Apply sine wave sweep signal to each loudspeaker system with a two minute sweep from 20Hz to 550Hz, to 10 - 15dB below full system output. Annotate issues discovered during sweep test. Correct issues resulting from the new system equipment and / or rigging hardware.
- E. Contractor shall provide all required equipment and programming to provide a fire alarm override. All audio shall mute in all local sound systems during a fire alarm.
- F. Contractor shall provide all cabling, connectors, components and equipment required for a complete and functional system.

PART 2 – MATERIALS

- A. All equipment shall be new and unused unless otherwise noted.
- B. Contractor shall provide all necessary patch cables, riser/plenum cabling and connectors interconnecting all equipment to provide for fully functional systems. In addition, all cabling raceway, support systems, sleeves and any other materials required to properly install and support cabling systems.
- C. All equipment quantities shall be as shown on drawings unless otherwise noted.
- D. All materials are to be provided as specified. No substitutions shall be accepted without written request from the Contractor and written consent of the Consultant.

2.12 FIRE ALARM OVERRIDE

- A. Provide for Fire Alarm Override for each Local Sound system. Contractor shall provide all cabling, relays, mounting hardware and any other devices (Fire Alarm System devices by others) to provide a fully functioning Fire Alarm Override system. When Fire Alarm is active, each Local Sound System shall be muted. When Fire Alarm ceases, each Local Sound System shall automatically revert to normal operation.

2.13 SCHOOL INTERCOM PUBLIC ADDRESS OVERRIDE

- A. Provide for School Intercom Public Address Override for each Local Sound System. Contractor shall provide and install (1) RDL TX-70A, 70v to Line level converter. Contractor shall provide, install and terminate cabling to nearest School Intercom speaker and shall integrate devices into local sound system. Provide DSP programming to duck Local Sound System to give priority to the School Intercom PA System. Coordinate with Building Intercom Contractor for integration of systems

2.14 CABLE ROUTING/PATHWAY

- A. Cable Support System: All audio-video cabling shall be installed and supported using a cable support system at 4'-0" intervals unless installed in conduit. Do not exceed manufacture recommendation for the quantity of cables supported in an individual support.
- B. All cable bundles shall be grouped together using plenum rated Velcro for the entire run above and below the ceilings.

2.15 AUDIO-VIDEO SYSTEM WIRING AND TERMINATING HARDWARE

- A. Cabling:
 - 1. Provide a complete audio/video cabling solution from back of each faceplate to device I/O locations as designated on the contract drawings. Each cable provided shall be installed with a minimum of 10' of excess slack above each outlet location. Contractor shall properly support and label all cabling at each outlet.
 - 2. Contractor shall ensure all cabling requirements are met to provide fully functional A/V systems, specified cabling notwithstanding.
 - 3. Contractor shall provide data, video, USB, audio and fiber patch cables for each system.
 - a. Data patch cables – Provide Panduit TX6A-28™ patch cables on a per port basis.
 - b. Video patch cables – Provide Extron HDMI Ultra series patch cables for each video field device and rack equipment. Provide Extron HD Pro Plenum Series optical patch cables where applicable.
 - c. USB patch cables– Provide Extron USB A-B and C series patch cables for all field devices and rack equipment.
 - d. Audio patch cables - Provide Whirlwind MK4 series microphone patch cables for all field devices with microphone inputs/outputs on a per port basis.

2.16 AV SYSTEM SCHEDULING, MONITORING AND CONTROL

- 1. Contractor shall program the QSYS control system to automatically shutdown system everyday at midnight 12am CST and recall a default configuration. This includes putting all amplifiers in standby, projectors lamped off, lifts, shades and projector screens raised, video walls and displays put into standby.
- 2. The contractor shall program a UCI for the District Systems Administrator to access from a district computer with QSYS UCI Viewer, password protected.
- 3. This UCI shall provide all system diagnostics including but not limited to, system wide device health, network audio metering, ptz camera feeds, network video streams per room, display, projector and projector lift status; with the ability to control each rooms UCI remotely.

4. The contractor shall provide the district with QSYS Reflect Enterprise Manager professional tier services during the warranty period for all systems and peripherals.

2.17 GYM

A. LOUDSPEAKERS

1. 20 qty. JBL AM5212/00 12-inch 2-Way Loudspeaker with 100° x 100° Horn
2. 6 qty. JBL ASB4128 Dual 18-inch Subwoofer

B. RIGGING HARDWARE

1. 10 Adaptive Technologies Group SB-18, 18 inch Rigging Swivel Beam.
2. 14 JBL 229-00009-01 , 3-pack of M10 x 35 mm forged shoulder steel eyebolts.
3. 14 Adaptive Technologies Group SC-188-96-SS, 96" Safety Cable with 1/4" Shackles, Stainless Steel.
4. 14 Adaptive Technologies Group TCK-022-S, 22" Adjustable Tilt Cable Kit, Silver.
5. 2 Adaptive Technologies Group SB-30, 30 inch Rigging Swivel Beam.
6. 2 Adaptive Technologies Group TCK2-030S, 30" Silver Double Pulley Speaker Tilt Cable Kit Assembly.

SPEAKER RIGGING HARDWARE NOTE:

Contractor to provide additional steel cabling, mounting hardware and materials as required for hanging the 20 main speakers and 6 subwoofers, per gym. Materials and hardware used must be rated with a safety factor of 5 to 1, as a minimum, based on the total weight of the speakers and mounting components.

C. AMPLIFIERS

1. 4 qty. QSC CX-Q 8K8, Eight-Channel Network Amplifier for the Q-SYS Platform.

D. DSP, CONTROL AND PERIPHERALS

1. 1 qty. QSC TSC-70-G3, 7" Touch screen controller.
 - a. 1 qty. Honeywell CG512A1009 Large Thermostat Guard.
 - b. Provide 5 sets of keys.
2. 1 qty. QSC Core 110F.
 - a. Lan A for QLAN/Dante, Lan B for internet access.
 - b. Coordinate with the District IT department to provide internet access.
 - c. Provides DSP for Gym C152.
3. 1 qty. QSC UCI Deployment license.
4. 1 qty. QSC Scripting license.
5. 1 qty. QSC 32 X 32 Dante license.

6. 1 qty. QSC Microsoft Teams license.
7. 1 qty. QSC QIO-GP8X8 GPIO expander.
 - a. For fire muting and intercom ducking.
8. 1 qty. Attero Tech unD6IO-BT- double-gang US Bluetooth Wall Plate Interface.

E. AUDIO NETWORK

1. 1 qty. M4250-26G4F-PoE+ (GSM4230P) 24x1G PoE+ 300W 2x1G and 4xSFP Managed Switch
2. 1 qty. CommScope 760162800 | UNP-6A-DM-1U-24, 24 Port Cat6a Patch Panel.

F. PLATES AND PANELS - All custom wall plates shall be manufactured by ProCo, RCI or Whirlwind. Anodized aluminum, BLACK with white lettering in 1/8" Sans Serif font.

1. 2 qty. "WPIO" – 12"X12"X1/8" Custom Whirlwind anodized aluminum panel.
 - a. 4 qty. Neutrik NC3FD-L-B-1, 3 pole female panel mount XLR connectors.
 - b. 4 qty. Neutrik NC3MDM3-L-B-1, 3 pole male panel mount XLR connectors.
 - c. 2 qty. Neutrik NE8FDX-Y6-B, Cat6a ethercon panel mount connectors.
 - d. 2 qty. Neutrik UMNO2-4FDW-A, OpticalCon panel mount connectors.
 - e. 1 qty. Hoffman ASE12X12X4, 8"X8"X4" NVENT pull box.
 - i. Installed by Electrical contractor.
2. 1 qty. 'APP' – 4RU Custom anodized aluminum panel with flange.
 - a. 8 qty. Neutrik NC3FD-L-B-1, 3 pole female panel mount XLR connectors.
 - b. 8 qty. Neutrik NC3MDM3-L-B-1, 3 pole male panel mount XLR connectors.
 - c. 4 qty. Neutrik NE8FDX-Y6-B, Cat6a ethercon panel mount connectors.
 - d. 4 qty. Neutrik UMNO2-4FDW-A, OpticalCon panel mount connectors.
3. ANTENNA PLATE, "W2".
 - a. ProCo 2 gang anodized plate, black with 2 qty 50 Ohm BNC connectors, 1 qty Atlas Sound AD-12BE and 1 qty Atlas Sound GN-13E flexible gooseneck – black.
 - b. Quantity and locations as shown on drawings.
4. ASSISTED LISTENING ANTENNA PLATE, "H".
 - a. ProCo single gang antenna plate with 1 qty. 50 Ohm BNC connector.
 - b. Quantity and locations as shown on drawings.

G. WIRELESS MICROPHONES

1. 1 qty. Shure ULXD4Q-G50, Quad channel digital wireless microphone receiver.
2. 2 qty. Shure ULXD2SM58-G50, wireless microphone handheld transmitter.
3. 2 qty. Shure ULXD1-G50, wireless microphone bodypack transmitter.
4. 2 qty. Shure SM31FH Fitness headset microphone.
5. 2 qty. Shure WA360 mute switches.
6. 2 qty. Shure SBC200, 2 bay charging station for wireless microphone transmitters.
7. 4 qty. Shure SB900B, rechargeable wireless microphone batteries.
8. 1 qty. RF Venue DFIN – white, diversity antenna.
 - a. Provide wire guard to protect antenna.

H. WIRED MICROPHONES

1. 4 qty. Shure SM58S, dynamic handheld microphone.
2. 4 qty. K&M 210/9 KM21090, telescoping boom microphone stand.
3. 4 qty. Whirlwind MK430 MK4 Microphone Cable - 30 Foot.

I. MEDIA PLAYER

1. 1 qty. Denon DN-350UI, internet Radio and Media Player with Bluetooth® Technology.

I. ASSISTED LISTENING SYSTEM

1. 1 qty. LS-54-216 Assisted Listening System
2. 1 qty. LA-124 antenna. Install at locations shown on drawings.
3. Provide enough LR-4200-216 Receivers to meet TAS and ADA standards as required by law.
4. Provide with each additional LR-4200-216 Receiver:
 - a. 1 qty. LA-401 Ear Speaker.
 - b. 1 qty. LA-430 Earphone/Neck Loop Lanyard
5. Provide 1 qty. LA-124 antenna.
6. Coordinate with Architect for installation location of each LA-304 Signage Kit.

J. EQUIPMENT RACK AND ACCESSORIES

1. 1 qty. Middle Atlantic DWR-35-26PD, pivoting wall mount rack.
2. 1 qty. Middle Atlantic PDX-920R-SP, Rackmount Power, 9 Outlet, 20A with Series Surge Protection.
3. 1 qty. Middle Atlantic UPS-2200R, Rackmount Uninterruptible Power Supply 1650W.
4. 1 qty. Middle Atlantic Products SS, 1RU Heavy duty sliding shelf.
5. 1 qty. Middle Atlantic D2LK – 2RU Locking Drawer.
6. 1 qty. Middle Atlantic FI-3.
7. 1 qty. Middle Atlantic DWR-FK6-32 Fan Kit.
8. 1 qty. Hoffman A121236T1T Nema Type 1 Wiring Trough.
 - i. Installed by Electrical contractor.
9. Install all rack mounted equipment with Middle Atlantic HTX, T20 Star Post, 10-32 security-screws.
10. Provide 5 extra front door keys to the Owner.
11. Provide front door.
12. Populate all unused rack spaces with blank panels.

K. USER CONTROL INTERFACE / TOUCH PANELS

1. Coordinate with Owner and Consultant for final UCI functionality and layout. Coordinate with Owner for Logo to be displayed on all UCI pages. Provide a numeric (0-9) passcode page immediately after the splash page. Provide a simple way for Owner to change and store new password from the UCI.
2. CONTROL PANEL UCI
 - a. The first page "SYSTEM START UP" shall have the text, "PRESS ANYWHERE TO START SYSTEM". The next page shall display a prompt requesting a passcode. Once the passcode is entered correctly, a System Start Up loading bar shall be visible. After the system has booted, the next page "HOME", shall allow for the selection of "Game Mode" with all loudspeakers unmuted or "Practice Mode" with only subwoofers and court speaker unmuted.
 - b. Once a mode has been selected the "MAIN MENU" page shall display buttons to select auto mixer, manual mixer, media controls and system shutdown.

- c. The "AUTO MODE" page shall include a system mute button, master output volume control fader with buttons to allow the user to navigate back to the home page or a system shutdown page.
- d. The "MANUAL MODE" page shall include a system mute button, channel fader volume controls, preamp controls and mutes for all available inputs, auxiliary buss assignments with buttons to allow the user to navigate back to the home page or system shutdown page.
- e. The "MEDIA CONTROLS" page shall provide transport controls for the Media player, interfaces for all available internet radio apps, Bluetooth pairing and allow the user to navigate back to the Auto mode, Manual Mode or Media Controls page.
- f. When system shutdown is selected, a prompt shall appear with the text "PLEASE CONFIRM SHUTDOWN". The user will then select a button labeled "Yes" or "No". If no is selected, the "HOME" page shall appear. If yes is selected, a system shutdown loading bar shall appear. All amplifiers and video displays/projectors shall be put in standby mode, and projector screens/lifts raised. Once the system shutdown sequence is complete, the "SYSTEM START UP" page shall be visible.

PART 3 – EXECUTION

3.1 WIRING AND INSTALLATION TECHNIQUES

- A. Coordinate all work with all other trades to avoid causing delays in construction schedule. Contractor shall expedite the delivery of materials and provide additional labor as required to meet construction deadline.
- B. Coordinate final connection of power and ground wiring to equipment racks by electrical contractor. Power and ground wiring shall terminate inside equipment racks on standard duplex outlets. Mount as to not interfere with internal equipment of the rack. Power shall be a dedicated circuit and not share with any other source. Ground per NEC with third wire (green) to panel ground lug at breaker supply panel.
- C. All equipment and enclosures described in this specification section shall be plumb and square. All equipment except portable equipment shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads with a safety factor of at least five.
- D. Wiring and installation under this contract to meet NFPA, NEC, and local code requirements where applicable.
- E. The process of equalizing and testing the Audio Sound System may necessitate moving and adjusting certain component parts (e.g., loudspeakers). This shall be done without claim for additional payment.
- F. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum. Separate all low level microphone and auxiliary inputs from speaker output conductors, data or other system wiring.
- G. All wiring shall be labeled using vinyl wire labeling tags. Use Brady™ model BMP21 or equal wire labeling printer. Label input, output and wireless wiring. Label electrical power

beaker at electrical panel. Label location of room and power panel/breaker at equipment rack. Protect labels with clear heat shrink.

- H. Label all mixer inputs with their respective input. Example: mixer input 1 – “Mic-1”, etc. Label to reflect name on engraved wall plate.
- I. Solder all microphone connections using rosin core solder. Use temperature controlled soldering equipment. Microphone XLR connectors shall use standard wiring code as follows: pin 1 shield/ground, pin 2 positive, pin 3 negative.
- J. Paint all back boxes and conduit prior to installation of wiring or connectors. Protect and do not paint any wiring or equipment rack cabinets.
- K. Install equipment cabinet in a controlled temperature, dry and accessible area. Provide sufficient space to completely open the front and rear of the cabinet. Equipment not to be in general gym area where it can be damaged.

3.2 CABLING

- A. General: Unless otherwise noted, provide the following cable types (or equivalent) for each application:
 - 1. West Penn 454 #22 AWG twisted pair / shielded for Microphone and Line level signals.
 - 2. West Penn C210 #10 AWG twisted pair for subwoofer / low frequency speakers.
 - 3. West Penn 227 #12 AWG twisted pair for conventional, full range sound reinforcement speakers.
 - 4. West Penn 226 #14 AWG twisted pair for 70v sound reinforcement speakers.
 - 5. West Penn 807X RG-8X coax cable for analog RF signal lines.
 - 6. West Penn 4246 CAT6 cable for Local Sound/Video Network and Dante digital audio devices.
 - 7. West Penn 4246F F/UTP CAT6 for digital audio snake devices.
 - 8. West Penn 4246AF F/UTP CAT6A cable for HDBaseT video devices.
 - 9. Provide plenum rated cable where required.

3.3 INSPECTIONS

- A. General: Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/ Designer may inspect before acceptance.
- B. Ensure all systems are installed to provide uniform, balanced audio coverage throughout each intended listening area. Ensure there are no rattles, buzzes, hums, RF interference, electro-static interference, feedback or other audible audio anomalies while the systems are in operation.
- C. Contractor shall use white / pink noise generator and audio spectrum analyzer to set overall frequency response and equalization. Ensure gain structure is properly set to prevent clipping on any device and to provide balanced system functionality. Provide proper limiter programming to prevent damage to all audio components. District Maintenance personnel to be on site during process.

- D. Demonstrate the performance of each system and give instructions of proper operation and maintenance to the Owner. Provide a minimum of eight hours of training and basic system operating instructions for each system in not more than four hour sessions. Include a list of system training attendees in the Close-Out Documentation.
1. Contactor shall record each training session with a 720p, minimum, digital video recording device, with audible audio, in .MOV or .MP4 format and compile sessions onto 128MB thumb drives (as many as required) (SanDisk, Kingston or PNY) and provide to Owner. Contractor shall title each video file with the room name of the system and date; e.g., "Dining Commons – August 15, 2019."
 2. Contractor shall provide an asbuilt QSYS designer file, Dante Controller preset, Shure wireless work bench inventory/RF coordination report and Netgear switch master configuration file supplied on a usb flash drive. In the event when systems are updated during service calls during the warranty period, the contractor shall furnish updated system files to the district.

END OF SECTION

SECTION 28 05 00 - GENERAL ELECTRONIC SAFETY SYSTEMS REQUIREMENTS

PART 1 – GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Furnishing of all required materials, equipment, tools, scaffolding, labor, and transportation necessary for the complete installation of the Electronic Safety Systems as shown on the drawings and as specified herein.
- C. Coordinate wireway, raceway, power, and outlet requirements with the builder and the electrical contractor.
- D. Cable pathways, conduit, boxes and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- E. The Electronic Safety Systems Contractor shall provide and install prior to cable installation plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- F. Supply in a timely manner to the electrical contractor special backboxes for installation as required.
- G. It is the intent of the Contract Documents to provide complete installations although every item necessary may not be specifically mentioned or shown.
- H. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.
- I. Provide line-by-line specification review for each Division 28 section annotated to certify compliance or deviation.

1.2 WORK TO BE INCLUDED BY THE ELECTRICAL CONTRACTOR IN BASE CONTRACT PROPOSAL

- A. Provide utility services conduit as outlined on drawings as required.
- B. All required conduit for accessibility to attic space.
- C. Furnishing and installation of all required standard back boxes and conduit.
- D. Installation of special back boxes supplied by Division 28 contractor(s).
- E. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.
- F. Provide equipment-mounting boards as outlined on drawings.
- G. Provide equipment grounding system, conductors, and bus bars and as outlined in Division 26.
- H. Provide 120-volt power and hook-up to equipment provided in Division 28.

- I. Coordination of requirements of Division 28 with the Builder.

1.3 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services. Contractors shall not make selection, purchase, or installation of interconnect instruments/equipment to be used on this project.

1.4 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.
- B. Section 26 05 34 - Provisions For Communication, Security & Safety Systems.

1.5 CODES, STANDARDS, AND THEIR ABBREVIATIONS

- A. General:
1. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
 2. In addition to the requirements outlined in other sections of the specifications the following standards are imposed as applicable to the work in each instance:
 - a. OSHA Safety and Health Regulations for Construction.
 - b. NFPA No. 70 National Electrical Code.
 - c. NESC National Electrical Safety Code, ANSI Standard C2.
 - d. NEIS National Electrical Installation Standards.
 - e. Local Codes and Ordinances.
- B. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof. Any such additional work shall be performed at no additional cost to the Owner.
- C. Materials and components shall be UL listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
- D. The Contractor shall obtain all permits required to commence work. Upon completion of the Work, the Contractor shall obtain and deliver to the Owner's Representative a Certificate of Inspection and Approval from the State Board of Fire Underwriters, the City of Little Elm, Texas, and other authorities having jurisdiction. The Contractor shall pay required permit fees.

1.6 LIST OF ASSOCIATIONS AND STANDARDS:

ADA:	Americans with Disabilities Act.
ANSI:	American National Standards Institute, 1430 Broadway; New York, NY 10018.
ASTM:	American Society for Testing and Materials, 1916 Race Street; Philadelphia, PA 19103.
BICSI:	(RCDD5 Standards), 8610 Hidden River Parkway, Tampa, FL 33637
CBM:	Certified Ballast Manufacturers Association, 2116 Keith Building; Cleveland, Ohio 44115.
IEEE:	Institute of Electrical and Electronics Engineers, 345 East 47th Street; New York, NY 10017.
ICEA:	Insulated Cable Engineers Association, P.O. Box P, South Yarmouth, MA 02664.
NEC:	National Electrical Code; NFPA No. 70.

NECA: National Electrical Contractors Association, Inc., 7315 Wisconsin Ave.;
Washington, DC 20014.
NEMA: National Electrical Manufacturers Association, 155 East 44th Street; New York,
NY 10017.
NESC: National Electrical Safety Code, ANSI Standard C2.
NFPA: National Fire Protection Association, 60 Batterymarch Street; Boston, MA
02110.
OSHA: Occupational Safety and Health Administration, US Department of Labor;
Washington, DC 20402.
TAS: Texas Accessibility Standards (TAS) Article 9102.
UL: Underwriters Laboratories, Inc., 333 Pfingsten Road; Northbrook, IL 60062.

- A. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
- B. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- C. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- D. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- E. Where local codes and ordinances are not in writing or on record but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.7 DEFINITIONS

- A. Approval: It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work. Approval by the Architect of any changes, submitted by the Contractor, will be considered as general only to aid the Contractor in expediting his work.
- B. The Builder: The primary contractor engaged to oversee the construction project. They may be technically described as a Construction Manager, General Contractor, Managing Construction Contractor, et cetera.
- C. The Contractor: The Contractor engaged to execute the work included a particular section only, although he may be technically described as a Subcontractor to the Builder. If the Contractor, engaged to execute said work, employs Sub-Contractors to perform various portions of the work included under a particular Section, they shall be held responsible for the execution of this work, in full conformity with Contract Document requirements. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various sections and phases of work may be properly coordinated without unnecessary delays or damage.
- D. The Electrical Contractor: The Electrical Contractor shall be engaged to execute the work included Division 26 only.
- E. PDF file or .pdf: The filename extension associated with "Portable Document Format" files, which are multi-platform computer files in the ISO 32000-1:2008 open standard format developed and licensed by Adobe Systems. These files are a digital electronic representation of text, documents, images, and technical drawings in a font and color-accurate fixed-layout format that is platform and display resolution independent. PDF files can be electronically transmitted, viewed, or printed with various free PDF reader application programs, and may allow markups/comments with various PDF editing application programs.

- F. Provide: Defined as requiring both the furnishing and installation of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

1.8 SCHEDULE OF VALUES, APPLICATION FOR PAYMENT

- A. The Contractor shall in accordance with the General Provisions of the Contract, including General and Supplementary Conditions, and Division 1, complete a Schedule of Values and Applications for Payment. When a portion of this work separately funded, including donations or E-Rate, the contractor shall accommodate this in the Schedule of Values and Applications for Payment. For E-Rate eligible portions of this work, the contractor will be required to participate in the E-Rate program, comply with all E-Rate regulations, and provide billing as needed. The contractor shall coordinate with the Owner to file Form 471 or latter edition and/or other forms as may be required.

1.9 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.10 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.11 SUBMITTALS

- A. Submittal procedures shall be per Division 1 - General Requirements.
- B. Provide a complete submittal for each section as specified.
- C. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- D. A submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- E. Each Product data submittal shall include:
 - 1. A cover sheet with the name and location of the project, the name, address, and

- telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 4. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 6. When the contract requires extended product warranties, submit a sample of warranty language.
 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
- F. Submit shop or coordination drawings, when specified or the required for the scope of work, which include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.
- G. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.12 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.
- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner revised plans showing "as installed" work.
- C. In addition to the above, the Contractor shall accumulate during the jobs progress the following data in PDF file format (preferred) or paper copies to be turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:
1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
 2. PDF file or paper copies of all Shop Drawing prints and CAD or BIM engineering drawing program files.
 3. Any software programs, data/programming files, passwords, special interface cables, or keys that may be needed to maintain or access equipment.
 4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 5. Any and all other data and/or plans required during construction.
 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - a. Builder and all Contractors.
 - b. Major Equipment Suppliers

- c. Submit communication systems warranties.

1.13 TRAINING

- A. Upon completion of the work and at a time designated by the Architect, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all Electronic Safety Systems equipment and systems.
- B. See other sections for time requirements.

1.14 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.
- B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide Electronic Safety Systems (including all hook-ups) complete in every respect and ready to operate.
- D. If clarification is needed, consult the Architect/Engineer.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.
- F. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.15 PRODUCT SUBSTITUTIONS:

- A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.
- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.

- E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.
- F. The Contractors' proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- G. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.
- H. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - b. The specified product is unavailable through no fault of the Contractor.
 - c. The manufacturer refuses to warranty the specified products as required.
 - d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
 - e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
 - f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by the Contractor originating the changes.

1.16 FUTURE USE CABLING

- A. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.
- B. Locations and Existing Conditions:
 - 1. Location and condition of any existing equipment or services, when shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.
 - 2. The Contractor will examine the site, verify all requirements, service points, and availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items that may be fairly implied as essential to the execution and completion of any and all parts of this project.

1.17 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.

- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

1.18 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As built (as installed) drawings and operations manuals.

1.19 PROHIBITED MATERIALS

- A. No new asbestos, lead, or materials containing these substances shall be permitted in this project. The Contractor shall consult the Architect concerning these materials if their presence is suspected. All work in or around existing asbestos or lead materials is at the sole risk of the Contractor and his personnel.

1.20 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.
- D. Patching of openings and/or alterations shall be provided by the Electronic Safety Systems Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping

materials and methods in accordance with NFPA and local codes.

1.21 MANUFACTURERS' INSTRUCTIONS

- A. All equipment and devices shall be installed in accordance with the drawings and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.
- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.22 INSTALLATION

- A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.
- B. The Electronic Safety Contractor shall coordinate installation of the systems with the Builder, Electrical, Mechanical, and Plumbing Contractors to ensure a complete working system for the Owner.
- C. Where required for accessibility all conduit and boxes for all Electronic Safety Systems shall be provided by the Electrical contractor as specified, including systems in Division 28, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with, and verify with Division 26 to provide required conduit and boxes at locations and heights as required.
- D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in- accessible areas, floors, chases, under slab, crawlspaces, or underground.
- E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.
- G. Provide stainless screw/bolt hardware wherever stainless devices are used and in potentially wet areas.
- H. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.23 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

- A. All costs to provide 10 additional fire alarm signals including all cable and devices as directed

by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 – PRODUCTS

A. Not Applicable

PART 3 – EXECUTION

A. Not Applicable

END OF SECTION

SECTION 28 05 44 – FIRST RESPONDER ANTENNA SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Design, furnish, install, and test a complete and operating in-building Emergency Responder Radio Antenna System/Distributed Antenna System ['system' or 'DAS'] to provide complete coverage for the public safety agencies as required by the local fire department, other agencies and the authority having jurisdiction [AHJ]. The system will support only Emergency Responder and Public Safety Land Mobile Radios ['LMR']. The system shall not support District Radio, Cellular, and/or Wi-Fi Signals.
- B. System design shall comply with International Fire Code (IFC) 510.4 and 510.5.
- C. Provide design compliant with local public service agency, fire department, local hospital district, law enforcement agencies and local authority having jurisdiction (AHJ).
- D. The system shall not support the distribution of the campus wireless network, cell phone systems or campus radio antenna system (CRAS).
- E. System shall provide coverage for at least 95% of all areas of the facility including elevators, stairwells and throughout all floors.
- F. System shall provide amplification of VHF, UHF, 700-900 Mhz, IP rating of 2 GHz.
- G. Minimum signal strength of -95 dBm throughout coverage area.
- H. System shall be able to support analog and digital communication systems simultaneously.
- I. Contractor to provide wiring riser diagram and detailed product listing as part of project submittal.
- J. All 120v. and conduit requirements for the operation of the system shall be coordinated with the project electrical contractor and electrical design. All power serving system shall be fed from emergency power. System shall be provided with two independent 120v. power sources (primary and secondary).
- K. System batteries shall be provided for system to provide a full 24 hours of operation.
- L. Overall design and pricing should be based upon a "worst case scenario" that the entire building needs antenna coverage throughout.
- M. Testing of the building to determine signal strength and coverage should be scheduled once the building structure, walls and roof have been built to determine overall antenna system needs.
- N. Main riser trunk from roof mounted antenna to headend equipment shall be either installed in 2 hour fire rated cable system or cabling routed through a 2 hour fire rated enclosure/shaft.
- O. Interface to building fire alarm system to provide supervisory operation to notify building fire alarm panel should antenna system malfunction.
- P. Provide supervised monitoring panel at administrative area to indicate status of power, trouble signals, antenna failure or low system battery.
- Q. Antenna system shall be installed in central location on roof of main building structure or where reception is best. Avoid visibility of the antenna from the parking lot if possible.
- R. Properly support all system cabling throughout building with dedicated cable supports at 5'-0" on center minimum. Do not share supports with other low voltage systems.
- S. Entire system shall be grounded per NFPA 70 NEC requirements.

1.2 WORK INCLUDES

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 apply to this Section.
- B. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of a complete Emergency Responder Radio Antenna System. The purpose is to extend and amplify the Emergency Responder and Public Safety Land Mobile Radio

FIRST RESPONDER ANTENNA SYSTEM

signals to a strength of 95% in all areas of the facility including elevators, stairwells and all floors.

- C. It shall be the responsibility of the Emergency Responder Radio Antenna System contractor to obtain all required permits, approvals and certifications from the authorities having jurisdiction.
- D. All fees associated with the licensing shall be paid by the Contractor.
- E. Testing of the system shall conform to the testing requirements as described in the International Fire Code [IFC] Section 510.5.3.
- F. All testing must be done on frequencies authorized by the FCC and in use by local agencies as directed by the Authority Having Jurisdiction [AHJ].
- G. Final acceptance and approval shall be required from the local AHJ.
- H. It shall be the responsibility of the Electrical Contractor to provide and install all conduit systems, standard electrical boxes, and operating power for the building access systems as outlined on the project drawings. This Contractor shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit. The BDA head end shall be hardwired to electrical power and on emergency power where possible.
- I. The Electrical Contractor shall provide 120-volt power as required through separate dedicated branch circuits, maximum 20 amperes each. Each such circuit shall be labeled at the power distribution panel as EMERGENCY RESPONDER RADIO SYSTEM. The location of all circuit breakers serving the Emergency Responder Radio Coverage System shall be posted in the control unit cabinets. Each cabinet and all surge protection devices shall be grounded securely to the building grounding system.
- J. Provide all testing, documentation, training, and warranty service contract as outlined in these specifications.
- K. Section shall include:
 - 1. Bi-Directional Amplifiers [BDA's]
 - 2. Distributed Antenna System
 - 3. Coaxial Cables
 - 4. Splitters and Directional Couplers
 - 5. Battery Back-Up System
 - 6. All other equipment and components necessary for a complete and functioning Emergency Responder Radio Antenna System.
- L. Specification Compliance: A letter shall be provided stating, by section and subsection, that the intercom system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- M. Contractor shall connect all back-up batteries per manufacturer's instructions.

1.3 SYSTEM PRICING, PHASING AND AWARD

- A. Proposed Contractor shall provide a proposal based on separate pricing for each of the following steps:

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1. Outdoor Testing of the Facility – This price shall include verifying the outdoor signal strength at the facility's location.
 2. Full Testing, in accordance with IFC Section 510 Grid Testing – This price shall include verification of signal strength throughout the entire facility.
 3. Emergency Responder Radio Antenna System Materials and Installation Pricing – This price shall include a full system design and installation, including costs for design, components, materials, labor and testing. This price shall be a "Worst-Case Scenario" situation, as though the entire facility must require coverage.
- B. The project must be budgeted as a complete set of processes, thus the reason for having all pricing, in a "Worst-Case Scenario" prior to performing any work. This pricing will provide a budget before the work begins.
- C. The award of this work will be made in phases, in accordance with the three (3) afore mentioned steps.
1. Phase I award authorizes step #1. Once step one is completed, results are to be provided to the General Contractor, Architect, and Engineer for review. Following this review, step two may be delayed, pending adjustment to the donor signal. If donor signal strength at the facility does not meet IFC Section 510 requirements, the AHJ must be consulted, prior to moving to step two. If the donor signal strength is adequate to meet IFC Section 510 requirements, authorization for step two will be given.
 2. The Phase II award authorizes step #2. Testing of the facility to determine signal strength status and to provide a base for a full system design. After testing, a final revised proposal for a full system design, installation and final testing shall be issued to the General Contractor for review. No further work is authorized until award of Phase III is granted.
 3. Phase III award authorizes step #3. Design, installation and final testing of the Emergency Responder Radio Antenna System. Provide design and final acceptance testing documents per Section 1.8.

1.4 MANUFACTURERS

- A. Subject to compliance with requirements, available integrators offering products that may be incorporated in the work include, but are not limited to:
1. Commscope
 2. Farenhyt
 3. Axell Wireless
 4. Tessco
 5. Times Microwave
 6. Gamewell-FCI
 7. Notifier
 8. SOLiD Technologies – Alliance Corporation
 9. Simplex
 10. Westell
 11. Other manufacturers upon approval.
- B. Headend cabinet shall be NEMA 4 rated weatherproof enclosure.
- C. The AC power cable to the antenna amplifier shall be hardwired. Any non-hardwired antenna amplifiers shall not be accepted.

1.5 RELATED SECTIONS

- A. Section 26 05 34 - Provisions for Communication, Security & Safety Systems.

B. Section 28 05 00 - General Electronic Safety and Security System Requirements.

C. Section 28 46 21 – Fire Detection and Alarm System

1.6 CODES AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
- B. The equipment, materials, and installation shall confirm to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
 - 1. NFPA 1 – The National Fire Code (including Annex O from 2009)
 - 2. NFPA 70 – The National Electrical Code
 - 3. NFPA 72 – National Fire Alarm Code
 - 4. NFPA 1221 – Standard for the Installation, Maintenance and Use of Emergency Services Communication Systems
 - 5. UL 2524 - 1st Edition In-building 2-Way Emergency Radio Communication Enhancement Systems
 - 6. FCC 47 CFR Private Land Mobile Radio
 - 7. FCC 47 90.219-2007 Services-Use of Signal Boosters
 - 8. ICC 2009 International Fire Code, Code and Commentary
 - 9. ADA “Americans with Disabilities Act”
 - 10. FCC’s OET 65 Standards “Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”
 - 11. FCC Rules Part 22, Part 90, and Part 101

1.7 DEFINITIONS

- A. Attenuation: The reduction in signal power, expressed in decibels, as a result of coupling, heat loss, or transmission distance in a cable or in air.
- B. Bi-Directional Amplifier [BDA]: A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage. Also known as a signal booster.
- C. Coupled Bonding Conductor [CBC]: a bonding conductor placed on the outside of any technology cable. Used to suppress transient noise.
- D. Delivered Audio Quality Definitions [DAQ]: The universal standard often cited in system design, specifications, and testing reports for ERRC and DAS.
 - 1. DAQ 1: Unusable, speech present but not intelligible.
 - 2. DAQ 2: Understandable with considerable effort. Frequent repetition required due to noise and/or distortion.
 - 3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise and/or distortion.
 - 4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise and/or distortion
 - 5. DAQ 4: Speech easily understood. Occasional noise and/or distortion.
 - 6. DAQ 4.5: Speech easily understood. Infrequent noise and/or distortion.
 - 7. Speech easily understood.
- E. Distributed Antenna System [DAS]: A network of service antennas connected at intervals along shielded coaxial transmission lines and all connected to head-end electronics amplifying the signals to be distributed. Often refers to a system that includes both the passive distribution system and the active amplifying electronics.

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- F. Directional Coupler: A component which directs a small portion of downstream RF energy to a port which can be connected to an antenna or another branch of distribution cabling, and also serves as a combiner of upstream energy between the tap port and through the connection port.
- G. Donor Antenna: The antenna, usually mounted on the outside of a structure where a DAS is installed, which picks up signals over-the-air from a donor source.
- H. Donor Source: The repeater, transceiver, cell site, or other radio site that produces signals which a DAS will relay and distribute.
- I. Emergency Responder Radio Antenna System [ERRAS]: A two-way radio communication system installed to assure the effective operation and coverage of radio communications systems for fire, emergency medical services, and/or law enforcement agencies within a building or structure. The system is not designed for use with District LMR, Cellular Services, or Wi-Fi Services.
- J. Federal Communications Commission [FCC]: federal agency responsible for implementing and enforcing America's communications laws and regulations.
- K. OET 65 Standards: The FCC's Bulletin that provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- L. Public Safety and/or First Responder: agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to, law enforcement, fire departments, and emergency medical services.
- M. Reflected Power: Power which is reflected back along a transmission line as a result of discontinuities in line impedance caused at connectors or close proximity of metallic objects.
- N. Radio Frequency [RF]: Energy from electromagnetic waves, or alternating currents that produce electromagnetic waves, in the spectrum of radio frequencies (30 kHz to 300GHz)
- O. Signal Booster: See BDA
- P. Splitter: A passive component that has a single input port and two or more output ports, effectively splitting the signal equally amongst the output ports. It also serves to combine upstream signals from the "output" ports into composite signals at the "input" port.

1.8 SUBMITTALS

- A. Submittal procedures: See Section 28 05 00.
- B. Submit a complete submittal package within 30 calendar days, for approval, after award of this work. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- C. Submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- D. Quality Assurance Submittal:
 - 1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 - 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the

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- proposed system is based on the latest hardware, software technology and products comply with specified requirements and FCC Regulations.
3. The system described in the submittals shall be certified by an FCC Licensed Designer and installation shall be supervised by an FCC Licensed Project or Installation Manager.
- E. Product Data Submittal including special boxes, cable and other material as requested by the Architect/Engineer including:
1. A cover sheet with the name and location of the project, the name, address and telephone number of the Contractor and the name, address and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 2. Copies of FCC Licenses for both the Designer and Project or Installation Manger.
 3. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 4. A product data index and complete equipment list including for each product submitted for approval the manufacturers name and part number including options and selections.
 5. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle or other means) on each sheet the exact product and options being submitted for approval.
 6. Submit design data when the scope of work requires, including passband curves for both uplink and downlink for all bands, calculations, schematics, risers, sequences or other data.
 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
 8. Any rejected submittals must be corrected and resubmitted to the AHJ and Architect/Engineers within 10 days of receipt of the rejected material.
- F. Submit shop drawings locating all components of the system, indicating circuit routing, cable type, and gauge. Shop or coordination drawings shall include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, risers, floor plans and accurate to scale, (minimum of 1/8" = 1'-0"), equipment and device layouts prepared using a CAD or BIM engineering drawing program.
- G. Testing
1. Submit all field test records of the radio systems. These shall include, but not be limited to:
 - a. Preconstruction Tests – Tests performed with the AHJ prior to construction of the new facility to verify that the municipality has signal coverage in that area.
 - b. Mid-Construction Tests – Tests performed with the AHJ during construction, once walls have been constructed and the exterior roof is installed.
 - c. Final Testing – Tests performed in conforming with IFC Section 510.5.3 and Section 510.6. This testing is to be signed off by the AHJ. Engineers shall also be present for the final testing process.
 2. All testing records shall be submitted with O&M information and close out documents.
 - a. Provide one (1) digital copy of all close out documents
 - b. Provide three (3) copies of closeout documents bound in a 3-Ring binder with dividers and table of contents.

1.9 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Contractor shall have at least 5 years of experience installing, servicing and supporting building radio antenna communication systems and factory authorized representative of

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system.

- B. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
- C. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the emergency responder radio coverage system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing emergency responder radio coverage systems for a period of at least 5 years.
- D. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/ Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- E. The Contractor shall employ factory trained technicians capable of supporting the maintenance of the system. No contract employees are allowed unless they have been to the factory service school within the last 18 months. A certificate of this training shall be provided with the Contractors submittal.
- F. The contractor shall employ full time local technicians and installers. The manufacturer shall maintain a full-time factory employed service staff for product support and service.
- G. The proposed Contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period.
- H. All testing shall be conducted, documented and signed by a person in possession of an FCC General Radio Telephone Operators License and be a full-time employee of contractor.
- I. The proposed contractor shall be fully experienced in the design and installation of the type of system herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of a qualified person to contact for reference. This list must contain at least two (2) projects within a 150-mile radius of the school district to allow school administration officials to visit the job site for review of the system installation and service. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.
- J. The Proposed Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response. A Proposed Contractor that has any prior finding(s) of a code or license violation or has any litigation in process concerning the installation of a system is unacceptable.
- K. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
- L. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- M. The Owner may investigate, as they deem necessary to determine the ability of the proposed

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Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.

- N. The Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- O. The Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The system shall conform to the requirements as identified in IFC Section 510.4 and Section 510.5. Testing records are required to confirm performance of the system.
- B. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna systems, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.
- C. Power Supplies: At least two (2) independent and reliable power supplies shall be provided: one primary and one secondary. The primary power source shall be supplied from a dedicated 20-ampere branch circuit and comply with 4.4.1.4 of NFPA 72. The secondary power source shall be a dedicated battery back-up, capable of operating the in-building system for at least 24 hours at 100% operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 type enclosure. Monitoring the integrity of the power supplies shall be in accordance with 4.4.7.3 of NFPA 72.
- D. Survivability
 - 1. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from fire using one of the following methods:
 - a. A 2-hour fire rated cable or cable system
 - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
 - 2. Cabinet: The signal booster and all associated equipment shall be housed in a single NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting from inside of the cabinet to outside atmosphere. Equipment installed on the roof of structures shall be rated for the expected extreme temperature and weather associated with rooftop installation.
 - 3. Rooftop Installations shall require a Pitch Pocket for proper weather-tight roof penetrations.
 - 4. Passive equipment: Passbands shall be VHF, UHF, and 700-900 MHz, IP rating of 2GHz.

2.2 SYSTEM COMPONENTS

- A. Signal Strength
 - 1. Downlink: A minimum signal strength of -95dBm shall be provided throughout the coverage area.
 - 2. Uplink: A minimum signal strength of -95 dBm shall be received at the local municipality from the coverage area.
 - 3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.
- B. Permissible Systems
 - 1. Buildings and structures shall be equipped with an FCC Certified Class B Bi-Directional

- VHF, UHF, and 700-900 MHz amplifier(s) as needed.
2. The distributed antenna system may utilize a radiating cable, fixed antennas, or a combination of both.
- C. Supported Frequencies: The system shall support VHF, UHF, and 700-900 MHz as required for local public safety and first responder bands as utilized by the local municipality.
 - D. Reject Filters: Notch filter sections shall be incorporated as necessary.
 - E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes with the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.
 - F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.
 - G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations and/or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) shall not be implemented as the standard mode for public safety applications.
 - H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.
 - I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.3 SYSTEM MONITORING

- A. The distributed antenna system shall include connections to the fire alarm system to monitor the operational integrity of the signal booster, power supplies and annunciate malfunctions on the fire alarm system. Coordinate and provide this integration, as part of this system, with the fire alarm system contractor that is authorized to service the facility's fire alarm system. The integration of the DAS with the fire alarm system shall comply with Chapter 10 of NFPA 72.
- B. A sign shall be located at the fire alarm panel with the name and telephone number of the local municipality indicating that they shall be notified of any failures that extend past the 2-hour time limit.
- C. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 1. Normal AC power
 2. Signal booster trouble
 3. Antenna Failure
 4. Loss of normal AC power
 5. Failure of battery charger
 6. Low battery capacity

2.4 CABLE ROUTING, INSTALLATION, AND SUPPORT

- A. System wiring, and equipment installation shall be in accordance with good engineering practices. Wiring shall meet all state and local electrical code requirements.
- B. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
- C. Cable pathways, conduit, and cable support systems shall be complete with bushings, deburred, cleaned, and secure prior to installation of cable.
- D. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
- E. In all exposed areas such as mechanical rooms, parking garages, stairwells, etc., cable shall be fully enclosed in conduit.
- F. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling.
- G. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation. Route cable in a professional, neat, and orderly installation.
- H. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- I. Cable must not be fastened to electrical conduits, mechanical ductwork or piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. System cables shall not be run loose on ceiling grid or ceiling tiles.
- J. Provide for adequate ventilation to all equipment housings and take precautions to prevent electromagnetic or electrostatic hum.
- K. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- L. Each cable run shall be free of splices. No terminations, splices, or equipment will be installed in or above ceilings.
- M. Do not route any communication cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- N. System cable will not be installed in the same conduit, duct, or track with line voltage electrical cable.
- O. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

PART 3 EXECUTION

3.1 COORDINATION

- A. Contractors shall coordinate with an FCC licensed engineering firm regularly employed in the business of designing and implementing Emergency Responder Radio Antenna Systems for

FIRST RESPONDER ANTENNA SYSTEM

emergency responders.

B. Electrical Work:

- a. Proposed Contractor is required to provide for and coordinate with Electrical Contractor for any, and all required electrical work, including but not limited to, circuiting, conduits, back boxes, and more. These expenses will not be included in the electrical contractor primary bid.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
- B. Store and protect equipment in a conditioned space until installation.

3.3 SYSTEMS INSTALLATION

- A. Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
- B. All equipment shall be connected according to the OEM's specifications to insure correct installation and system performance.
- C. Coordinate all roof penetrations with General Contractor and/or Roofing Contractor.

3.4 GROUNDING

- A. Ground cable shields and equipment per Manufacturer's requirements.
- B. Antenna mast shall be grounded per NFPA 70 NEC requirements and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing lightning protection system.

3.5 TESTING, WARRANTY SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and testing of the system and it shall be subject to the final acceptance of the Architect/Engineer and Owner. All testing shall meet the testing standards set forth in IFC Section 510.
- B. This contractor will thoroughly test all components of the systems and devices proposed herein to assure equipment specifications are met. This contractor will start up, test, and debug systems to ensure that all aspects of the system are working, documented, and reporting properly.
- C. This Contractor shall make a thorough inspection and test of the complete installed Emergency Responder Radio Antenna System including all components and controls to ensure the following:
 1. Complete and functional system.
 2. Installed in accordance with manufacturer's instructions.
 3. Verify proper operation and processing of signals.
 4. Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
 5. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense.
- D. A final System Acceptance Test shall be performed in the presence of a designated Owner representative and the AHJ. In the event that a system does not pass or only partially passes the Acceptance Test, the Project Manager will file a discrepancy report. Corrected items will

be re-tested via a punch list to ensure that they comply with the system requirements.

- E. This Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment, cabling or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.
- F. Immediately prior to the end of the warranty period, the system shall be inspected and certified for the following year at no additional cost to the Owner.

3.6 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all calculation sheets used to configure the system.
- D. Formal on-site training sessions shall be conducted by the Emergency Responder Radio Antenna System contractor. It shall be the responsibility of the Contractor to coordinate time and location of training sessions with the Owner. Provide documented general instruction as follows:
 - 1. Provide instruction to the maintenance personnel to include the location, inspection, normal maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.
 - 2. Provide instruction to designated personnel on the functions and operation of the system provided including capabilities, limitations, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the system. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

SECTION 28 13 00 - ACCESS CONTROL SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- A. Division 08 – Door Hardware Sections.
- B. Division 26 – Electrical Sections.
- C. Division 28 – Low Voltage Sections:
 - 1. This contractor to be responsible for the access controls system.

1.3 SUMMARY

- A. The Contractor shall furnish and install a complete Cloud-based access control system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, network cabling, fittings, and all other accessories required to provide a complete and operable system.
- B. Security system devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of specification, The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- C. Additional Responsibilities of the Access control contractor are as follows:
 - 1. Input all Access Control Doors, Door Position switches, Door Release buttons, Keypads and all other devices into SMS and Mapping Feature.
 - 2. The mapping feature shall be programmed for complete monitoring of all devices, as well as complete functionality of Doors. Features shall include but shall not be limited to
 - a. Lock
 - b. Unlock
 - c. Lockdown
 - d. Position
 - e. Alarm for Propped Door
 - f. Alarm for Forced Door
 - 3. Package and return all unused door hardware installation components. All components that are turned over to the owner must be inventoried by integrator.
- D. Contractor shall integrate the Access Control system with the Video Surveillance system that in the event of a door open, the camera covering that door shall record the event as long as motion is being made in the view and for 5 seconds after motion ceases.
- E. Contractor shall provide all permits, licenses and system certifications as required by Authority Having Jurisdiction.

- F. Prior to construction, the contractor shall perform a test of all existing Access Control system devices and cabling. Should any faulty devices or cabling be found, contractor shall provide a list of faulty equipment and provide to the Architect and Owner. Contractor shall provide pricing to repair / replace any faulty device / cabling

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate with Owner or Owner's representative regarding network configuration and estimated bandwidth utilization prior to performing network connections.
- B. Pre-Construction Meeting:
- a. The successful Contractor shall attend a mandatory pre-construction meeting with the project's consultant and individuals deemed necessary by the Owner's representative prior to the start of the work. No work shall begin prior to this meeting.

1.5 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
1. National Fire Protection Association Standards:
 - a. NFPA 70 National Electric Code.
 - b. NFPA 72 National Fire Alarm Code.
 - c. NFPA 101 Life Safety Code.
 2. Local & State Building Codes.
 3. Requirements of Local Authorities having Jurisdiction.
 4. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.
 5. Requirements of American Disabilities Act (Public law 101-336).
 6. Accessibility Standards.
 7. State Fire Marshall.

1.6 QUALITY ASSURANCE

- A. Contractor Qualifications:
1. The installing contractor shall be the authorized dealer/integrator of the project's specified Avigilon Access Control System to sell, install, and service product and all related equipment.
 2. The installation contractor shall have represented the access control manufacturer's product for at least five years.
 3. The installation contractor shall be licensed by the State of Texas as a security services contractor to design, sell, install, and service security alarm systems.
 3. The installation contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
 4. The installation contractor shall have personnel on their staff that have been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least five (5) years.
 5. The installer must be in good standing by the manufacturer before the bid date.
 6. The Installer must be capable of providing references that will attest to successful completion of projects of similar scope as the work noted in this section.
 7. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the access control system. No person is allowed to work on the system without proper manufacturer's certification.
 8. The proposing contractor for this system and the installing contractor for this

- system shall be of the same organization.
9. Contractor must be a current integrator of solution in the closest major metropolitan area marketplace, have a permanent office located within 120 miles of the project, and be able to include information on current support staff to be able to service this client.
 10. Supplier Certifications: Provide products from a supplier in compliance with the following:
 - A. National Defense Authorization Act for Fiscal Year 2019.
 - B. SOC 2 Type 1 and Type 2.

1.7 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
 1. Control panel wiring and interconnection schematics for all devices
 2. Complete point to point wiring diagrams.
 3. Riser diagrams.
 4. Complete floor plan drawings locating all system devices.
 5. Factory data sheets on each piece of equipment proposed. Pertinent information is to be highlighted. All non-pertinent information is to be removed or crossed out.
 6. Complete system bill of material.
 7. Specification Compliance: A letter shall be provided stating, by section and subsection, that the Access Control installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- B. Product Data: Manufacturer's product information and data sheets for each product specified in this section, including:
 1. Substrate preparation instructions and recommendations.
 2. Installation means and methods.
 3. Recommendations and requirements for proper storage and handling.
- C. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

PART 2 – PRODUCTS

2.1 SUMMARY

- A. Cloud-based access control basic functionality, including an online administrator portal for managing dashboards, cameras, users, sites, security devices, reports, third-party software integrations, rules, alerts, alarms, and account profiles.
 1. All on-prem hardware talks outbound to the cloud host.
- B. Connect All Access Control Panels to the Owners Network. All cables shall be terminated on Patch Panel and labeled. All cables installed shall use only products required in the Structured Cabling Specification. All cables installed must carry the full manufactures warranty.

2.2 MANUFACTURERS

A. Basis of Design Manufacturer: **Avigilon Alta Access**

1. Address: 500 W Monroe Street, Ste 4400, Chicago, IL 60661, USA.
2. Phone: +1 (888) 281-5182
3. Website: www.motorolasolutions.com

2.3 CLOUD-BASED ACCESS CONTROL HARDWARE & INTEGRATIONS

- A. Provide all necessary hardware/controller/software/licenses required to operate and manage system effectively for the locations indicated on the drawings.
- B. Each access-controlled portal shall be equipped with:
1. One (1) HID Signo Reader
 2. Door Position Sensor – All door contacts must be DPDT.
 3. Motion Request-to-Exit – (only if REX is not integrated into the door hardware)
 4. Electrified door hardware to be provided and installed by others. Lock power to door hardware shall be provided by the ACS integrator and centralized at MDFs and IDFs. ACS Integrator shall provide cabling and connections between the door hardware and the Access Control System.
 5. Access Control Portals shall not exceed 500' distance from the associated control panel.
- C. Provide door contacts on all exterior doors, regardless of whether they have a card reader. All door contacts shall be located on each individual door and report back to the access control panel on the door's status. The contractor is responsible for providing all door modules or input modules to be able to provide the status of any exterior door on campus.
- D. Panel Hardware: **Basis of Design in BOLD**
1. Avigilon Access Control Core Controller – P/N: OP-CR-ACC
 2. Avigilon Access Single Door Controller – P/N: OP-CR-SDC
 3. **Mercury MP Series Intelligent Controller - P/N: AC-MER-CONT-MP1502**
 4. **Mercury MR52 Reader Interface Panel - P/N: AC-MER-CON-MR52-S3B**
 5. **Mercury MR16IN Multi-Device Interface Panel - P/N: AC-MER-CON-MR16IN**
 6. **Mercury MR16OUT Multi-Device Interface Panel - P/N: AC-MER-CON-MR16OUT**
- E. Avigilon Access Control Controller
1. Avigilon Access Control Core Controller
 - a. P/N: OP-CR-ACC
 2. Compliance: UL 2043, FCC, IC, CE, RCM
 3. Communications:
 - a. Encryption: Communications to the access control cloud service shall be encrypted via TLS 1.2.
 - b. Connection to access control cloud service: Ethernet or Wi-Fi.
 - c. USB:
 - 1) Two 2.0 ports for expansion.
 - 2) Two 3.0 ports for expansion.
 4. Power: 12-24 VDC
 5. Capacity:
 - a. Up to 8 Entries
 - 1) 2 Avigilon 4-Port Expansion Boards
 - b. Up to 12 Entries
 - 1) 1 Avigilon 4-Port Expansion Board and 1 Avigilon 8-Port Expansion Board

- c. Up to 16 Entries
 - 1) 2 Avigilon 8-Port Expansion Boards
- F. Avigilon Access Single Door Controller - (Only to be used on portable building applications when shown on drawings)
 - 1. Openpath Single Door Controller
 - a. P/N: OP-CR-SDC
 - 2. Compliance: UL 2043, FCC, IC, CE, RCM
 - 3. Communications:
 - a. Encryption: Communications to the access control cloud service shall be encrypted via TLS 1.2.
 - b. Connection to access control cloud service: Ethernet or Wi-Fi.
 - c. Connection to credential reader: Bi-directional, four conductors, RS-485.
 - 4. Power: 12-24 V dc via 12V, 24V, PoE, or PoE+ supply.
 - 5. Capacity:
 - a. Credential Readers: Up to two.
 - b. Wiegand Readers: Up to two.
 - c. Relays: Two configurable wet 12/24 Vdc or dry.
 - d. Inputs: Up to four.
 - e. USB: Two ports for expansion.
- G. Approved third-party controller manufacturer: Mercury.
 - 1. **Basis of Design product: Mercury MP Series Intelligent Controller.**
 - a. **P/N: AC-MER-CONT-MP1502**
 - 2. Access Control:
 - a. Supports total of 1 RS-485 I/O protocol.
 - b. Activation/deactivation.
 - c. If/Then rule capabilities.
 - d. Anti-pass back support.
 - e. Nested, area, hard, soft and timed forgiveness.
 - f. Up to 264 inputs and 260 outputs.
 - 3. Door Control:
 - a. Natively supports up to 4 readers and 2 openings.
 - b. Support for up to 16 additional RS-485 expansion modules; max 32 entries.
 - 4. Power:
 - a. Primary Power:
 - 1) 12-24 VDC +/- 10%, 500 mA (reader and USB ports not included).
 - b. Reader Port:
 - 1) 600 mA maximum (add 600 mA to primary power current).
 - c. Micro USB Port:
 - 1) 5 VDC, 500 mA maximum (add 270 mA to primary power current).
 - d. Battery:
 - 1) Memory/Clock Backup: Super Capacitor (10 days). 3-volt Lithium, type BR2330 or CR2330 slot available for additional capacity (CR2330 battery not included).
 - e. Micro SD Card:
 - 1) Format: microSD or microSDHC; 2GB to 8GB.
 - f. Host Communication:
 - 1) Ethernet: 10-BaseT/100Base-TX and USB port (2.0) with optional adapter: pluggable model USB2-OTGE100.
 - g. Serial I/O Device:
 - 1) 2-wire RS-485, 2,400 to 115,200 bps, asynchronous, half-duplex, 1 start bit, 8 data bits, and 1 stop bit.
 - h. Inputs:
 - 1) 8 unsupervised/supervised, standard EOL: 1k/1k ohm, 1%, ¼ watt.

- 2) 2 unsupervised dedicated for cabinet tamper and UPS fault monitoring.
 - i. Output Relays:
 - 1) 4 relays, Form C; NO 5 A @ 30 VDC resistive; NC 3 A @ 30 VDC resistive.
 - 5. Reader Interface
 - a. Reader Power:
 - 1) 12-24 VDC +/- 10% regulated, 600 mA maximum.
 - b. Data Inputs:
 - 1) TTL compatible or 2-wire RS-485.
 - c. RS-485 Mode:
 - 1) 9,600 to 115,200 bps, asynchronous, half-duplex, 1 start bit, 8 data bits and 1 stop bit.
 - 2) Maximum cable length: 2000 ft (609.6m).
 - d. LED Output:
 - 1) TTL levels: high > 3 V; low < 0.5 V; 5 mA source/sink maximum.
 - e. Buzzer Output:
 - 1) Open collector, 12 VDC open circuit maximum, 40 mA sink maximum.
 - 6. Security and Network
 - a. IP connectivity via IPv4/v6.
 - b. Host communications protected by TLS 1.2/1.3 or AES-256/128.
 - c. Controller I/O expansion connection protected by AES.
 - d. Generate and load custom device and peer certificates in support of mutual TLS (mTLS).
 - e. Port-based network access control using IEEE 802.1X
 - f. FIPS 140-3 user of OpenSSL (in process).
 - 7. Cable Requirements
 - a. Power and Relays:
 - 1) 1 twisted pair, 18 to 16 AWG.
 - b. Ethernet:
 - 1) Cat-6A
 - c. Reader TTL:
 - 1) 6-conductor, 18 AWG, 500 ft (152 m) maximum.
 - d. Reader RS-485:
 - 1) 1 twisted pair, shielded, 120 ohm impedance, 24 AWG, 2,000 ft (610 m) maximum.
 - e. I/O Devices:
 - 1) RS-485 1 twisted pair with drain wire and shield, 120 ohm impedance, 24 AWG, 4,000 ft (1,219 m) maximum.
 - f. Alarm Input:
 - 1) 1 twisted pair, 30 ohms maximum typically 22 AWG @ 1000 ft (304.8 m) maximum.
 - 8. Compliance and Warranty
 - a. Product Compliance:
 - 1) UL 294 Recognized, FCC Part 15 Class A, CE Compliant, RoHS (2011/65/EU&2015/863), EU REACH (1907/2006), California Proposition 65, NIST Certified Encryption (in process).
- H. Approved third-party dual-card reader board manufacturer: Mercury.
- 1. **Basis of Design product: Mercury Series 3 Serial I/O Dual-Card Reader Interface Panel. - P/N: AC-MER-CON-MR52-S3B**
 - 2. Power:
 - a. Primary Power:
 - 1) 12-24 VDC +/- 10%, 500 mA

- b. Host Communication:
 - 1) RS-485, 2-wire, 4000' (twisted pair with shield).
 - 3. Reader Ports (2 per board)
 - a. Reader Power:
 - 1) Pass-through or 12VDC regulated 300mA each reader.
 - b. Card/Keypad Data:
 - 1) OSDP, Clock/Data, Data-1/Data-0, or RS-485
 - c. Output Relay
 - 1) 4 relays, Form C Contacts rated at 2 A @ 30 VDC resistive
 - d. Input Relay
 - 1) 6 unsupervised/supervised, standard EOL: 1k/1k ohm, 1%, ¼ watt.
 - e. LED Output:
 - 1) One-wire bi-color LED or two-wire LED
 - f. Buzzer Output:
 - 1) Only with 'one-wire' LED
 - 4. AUX I/O
 - a. Inputs:
 - 1) 8 General Purpose: Programmable circuit type
 - 2) 2 Dedicated: Tamper and Power Monitor
 - b. Output Relays:
 - 1) 6 Form-C Relay:
 - (a) Normally open contact (NO): 5A @30VDC resistive.
 - (b) Normally closed contact (NC): 5A @30VDC resistive.
- I. Approved third-party input board manufacturer: Mercury.
 - 1. **Basis of Design product: Mercury Series 3 Serial I/O 16-Input Interface Panel.**
 - a. **P/N: AC-MER-CON-MR16IN**
 - 2. Compliance: UL 2043, FCC, IC, CE, RCM
 - 3. Communications:
 - a. RS-485, 2-wire, 4000' (twisted pair with shield)
 - 4. Power: 12-24 VDC
 - 5. Capacity:
 - a. Relays:
 - 1) Inputs:
 - (a) 16 General Purpose: Programmable circuit type
 - (b) 2 Dedicated: Tamper and Power Monitor
 - 2) Outputs:
 - (a) 2 Form-C Relay:
 - (1) Normally open contact (NO): 5A @30VDC resistive.
 - (2) Normally closed contact (NC): 5A @30VDC resistive.
- J. Approved third-party output board manufacturer: Mercury.
 - 1. **Basis of Design product: Mercury Series 3 Serial I/O 16-Output Interface Panel.**
 - a. **P/N: AC-MER-CON-MR16OUT**
 - 2. Compliance: UL 2043, FCC, IC, CE, RCM
 - 3. Communications:
 - a. RS-485, 2-wire, 4000' (twisted pair with shield)
 - 4. Power: 12-24 VDC
 - 5. Capacity:
 - a. Relays:
 - 1) Inputs:
 - (a) 2 Dedicated: Tamper and Power Monitor

- 2) Outputs:
 - (a) 16 Form-C Relay:
 - (1) Normally open contact (NO): 5A @30VDC resistive.
 - (2) Normally closed contact (NC): 5A @30VDC resistive.
- K. Credential Readers:
 - 1. **Basis-of-Design Product: HID Signo Readers**
 - a. **HID® Signo™ Reader 40 – Wall Switch Mount Application**
 - b. **HID® Signo™ Reader 20 – Mullion Mount Application**
 - c. Avigilon Video Intercom Reader Pro.- Video Intercom & Reader Application
 - 2. Mullion mount Card Readers are acceptable only for locations where wall mounted readers cannot be installed flush on wall
 - 3. Credential Reader Power: Powered using 12-24 V dc from its associated controller, including its standby power source, and shall not dissipate more than 5 W.
 - 4. Communications:
 - a. Encryption: Communications to the access control cloud service shall be encrypted via TLS 1.2.
 - b. Connection to controller: Bi-directional, four conductor, RS-485.
 - 5. Enclosure: Suitable for surface, semi-flush, mullion, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:
 - a. Indoors, controlled environment.
 - b. Indoors, uncontrolled environment.
 - c. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.
 - 6. Display: LED indicator shall provide visible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
 - 7. Proximity Readers:
 - a. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.
 - b. The card reader shall read proximity cards in a range from direct contact to at least 1.5 inches (40 mm) from the reader.
 - c. The card reader shall support low (125 kHz) and high (13.56 MHz) frequency cards and fobs.
 - d. The reader shall detect touch and hand waving and authenticate with the mobile credential via BLE, NFC, and/or geoproximity.
 - e. The reader shall support remote over-the-air (OTA) software updates.
 - f. The reader shall support remote OTA troubleshooting, including identification and restarting services.
 - g. The reader shall not store sensitive or encrypted data locally on the device.
 - h. The reader shall support adjustable Bluetooth range and geolocation detection.
 - i. The reader shall support onsite-only, multi-factor authentication unlock methods.
 - j. The reader shall trigger mobile credentials via beacons, and shall support any beacon format, including iBeacon.
 - k. Credential Technologies:
 - 1) Avigilon Alta (formerly Openpath) Mobile Credential.
 - 2) Avigilon Alta Cloud Key and Guest Pass.
 - 3) Avigilon Alta 13.56 MHz DESfire (EV1, EV2, and EV3) Credentials.
 - 4) Avigilon Alta 125 kHz LF Prox.

- L. Video Intercom Credential Reader:
1. Basis of Design
 - a. **Openpath Video Intercom Reader pro**
 2. Video Credential Reader Power:
 - a. Can be powered from its associated controller, including its standby power source, and shall not dissipate more than 7.8 W.
 - b. Can be powered using Power over Ethernet (PoE).
 3. Communications:
 - a. Encryption: Communications to the access control cloud service shall be encrypted via TLS 1.2.
 - b. Connection to controller: Over the cloud or via Wiegand input.
 4. Enclosure: Suitable for surface, semi-flush, mullion, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:
 - a. Indoors, controlled environment.
 - b. Indoors, uncontrolled environment.
 - c. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.
 5. Display: LED indicator shall provide visible [and audible] status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.
 6. Camera: High resolution built-in camera shall record entry events.
 7. Proximity Readers:
 - a. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.
 - b. The card reader shall read proximity cards in a range from direct contact to at least 1.2 inches (30 mm) from the reader.
 - c. The card reader shall support low (125 kHz) and high (13.56 MHz) frequency cards and fobs.
 - d. The reader shall detect touch and hand waving and authenticate with the mobile credential via BLE, NFC, and/or geoproximity.
 - e. The reader shall support remote over-the-air (OTA) software updates.
 - f. The reader shall support remote OTA troubleshooting, including identification and restarting services.
 - g. The reader shall support adjustable Bluetooth range and geolocation detection.
 - h. The reader shall support onsite-only, multi-factor authentication unlock methods.
 - i. The reader shall trigger mobile credentials via beacons, and shall support any beacon format, including iBeacon.
- M. Access Control Cards:
1. Card Size and Dimensional Stability: Credential cards shall be [2-1/8 by 3-3/8 inches (54 by 86 mm)] The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.
 2. **Provide 1,000 access cards for this project. Integrator will be responsible for providing a temporary badging station to print initial ID badges before providing them to the owner. All cards shall be ordered with sequential serial numbers and coordinated with the manufacturer. District uses Card Integrators for preprinted district cards/ID Badges**
 3. Card Material: Abrasion resistant, nonflammable, nontoxic, and impervious to solar radiation and effects of ultraviolet light.

- N. Door Contacts –
1. **All door contacts must be DPDT.** Provide a door contact for each exterior door, and other doors as located on plans. Door Contact shall always monitor door position. Program the system to shunt alarm on authenticated card read. Send system into full alarm during forced door. Send system into trouble for Propped door with messaging to designated user groups for all alarm types. At a pair of doors, contractor shall wire each door contact together as one common program point within the access control system.
 - a. Recessed – P/N: 1076D-G
 - b. Surface Mount/ Roof Hatch– P/N: GRI 4405-A
 - c. Roll-up Door – P/N: 2315A-L
- O. REX -Motion Request-to-Exit –
1. **Bosh DS160** (only if REX is not integrated into the door hardware)
- P. Door release button – **SDC - D15-2** - Concealed Remote Desk Switch - SPDT Push Switch - Momentary - 10 Amp @ 30VAC/DC
- Q. Lock down button –
1. At each campus building, contractor to provide **BLUE** push button for campus lockdown, model: **SS2 434 LD-EN** with custom label: **LOCKDOWN**. Pushbutton to be in front office administration area and be momentary pushbutton style. Once building lockdown is activated, the system shall remain in lockdown mode until authorized personnel use system software to place the system back in normal mode. Coordinate with local campus principal on final location of button prior to rough in
- R. Access Control System Enclosures: **Basis of Design: LifeSafety Power**
1. **Two-Door Enclosure:**
 - a. **AC-LSP-2DR-MER-LCK**
 2. **Four-Door Enclosure:**
 - a. **AC-LSP-4DR-MER-LCK**
 3. **Eight-Door Enclosure:**
 - a. **AC-LSP-8DR-MER-LCK**
 4. **Sixteen-Door Enclosure:**
 - a. **AC-LSP-16DR-MER-LCK**
 5. The number of overall enclosures shall be based upon providing 120% of current project requirements to allow for future growth at each headend location. The contractor shall provide and install a wall mounted enclosure for all Door Controllers/Gateways/Input Modules that shall be installed.
 6. Door power supplies are part of this unit and shall be provided to interface with electrified door hardware.
 7. Provide labeling on the face of panel for identification of panel as named in the access control software. Typical naming convention is 3-digit initials of campus – B(XXX) where X represents initials of building – ACP#
 8. Provide label on inside of access control panel to indicate electrical panel and circuit number of 120v. power serving panel.
 9. Provide dual local batteries for each panel where internal cards are being powered.
 10. Contractor to wire internal contact relay to indicate when power loss occurs to panel.
 11. Contractor to wire internal relay contact for door latch to indicate when access to the panel has occurred.
 12. Provide all back plates and mounting hardware required for complete system installation.
- S. Supported Camera Hardware:

Avigilon Ava cameras connected through Alta Aware user account.

2.4 CLOUD-BASED ACCESS CONTROL MOBILE APPLICATIONS

- A. Encryption: Support mobile credentials via a mobile app with end-to-end encryption to administrative portal.
- B. Mobile app shall run in the background on a device with minimal battery usage.
- C. Devices Supported: Mobile devices with Android and IOS operating systems, including Apple Watch.
- D. Mobile app security:
 - 1. Mobile credentials shall be assigned individually or as part of an identity provider integration.
 - 2. Mobile credential to utilize a revolving NSA Suite B cryptographic algorithm, with the private key to be generated on the mobile device and never to be shared, only to use public key pairing.
 - 3. All communication for access control to use TLS1.2+ encryption.
 - 4. Mobile credential authentication shall use triple communication pathway: From mobile credential to reader over BLE, to panel over LAN Wi-Fi, to cloud and panel over Wi-Fi and LTE.
 - 5. Mobile credentials to be authenticated via Bluetooth, NFC, and/or geoproximity.
- E. Functions Supported:
 - 1. Touch entry.
 - 2. Hand wave.
 - 3. App unlock.
 - 4. Auto proximity unlock.
 - 5. Last-to-leave locking, allowing users to lock an entrance regardless of schedule.
 - 6. 24-hour activity log.
 - 7. Send diagnostic feedback.
 - 8. Activate lockdown plan.
 - 9. Share guest access link.
 - 10. Mobile credentials shall support custom virtual identification badges.
 - 11. Call, email, and send audit logs to technical support from the mobile credential.
 - 12. Trigger and revert lockdown plans from the mobile credential.
 - 13. Detect nearby readers based on RSSI strength.
 - 14. Reprovision mobile credential on a new or different device.
 - 15. Touchless elevator access control.
 - 16. Favorite entries list.
 - 17. Adjustable Bluetooth range and geolocation detection per door.
 - 18. Two-factor authentication.
 - 19. Unlock requests while mobile app is in background and mobile device is turned on, but not unlocked.
 - 20. Admin app: Provision wireless locks, download audit logs, and update access.
 - 21. Third-party Allegion ENGAGE mobile app: Commission Schlage enrollment reader and wireless locks into ENGAGE site and view real-time battery status.
- F. Logging into the mobile app:
 - 1. Support passwordless login.
 - 2. Support logging in with a password

2.5 COMPONENTS

- A. Panel Licensing:
 - 1. The contractor shall provide all enterprise licensing for all the panels being added as part of the current project work scope.
 - 2. The licensing should be configured to allow the district to have direct contact with the manufacturer's technical support staff in lieu of having to contact the local integrator for support.

- B. API Licensing:
 - 1. Integrator to provide all API licensing required for this project.
- C. Security Management System Client Workstation:
 - 1. The SMS client interface shall be 100% web based for local users interfaced with username and password support via active directory interface. Client license count shall still be (5) concurrent licenses per elementary school, (8) per Junior High and (10) per High School.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Prior to installation, ensure Access Control Hardware Appliance is capable of required Access Control Software Features and Integrations.

3.2 INSTALLATION

- A. Install system according to manufacturer's written instructions.
 - 1. Develop, install, and test software and databases for complete and proper operation of systems involved. Activate and install all software and accessory software licenses.
 - 2. Setup and program entire system so that no additional programming is required after Substantial Completion, including setup of available software features.
 - 3. Perform a full system backup at completion of initial programming and deliver configuration and transaction backups to Owner.
 - 4. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revisions to the Owner's operating requirements including the creation of time schedules, holidays, new card formats, etc. Create user hierarchy with access permissions. Set up notifications.
 - 5. Test equipment and configure system in accordance with instructions provided by manufacturer prior to installation.
- B. Ensure products are equipped with the latest and most up-to-date firmware and/or software by manufacturer.
- C. Review configurable features of device with Owner's Representative and establish a punch list for standard, device specific, location specific and access control software-specific configuration of device(s).
- D. Program and configure devices in accordance with the punch list so no additional programming is required for operation by user.
- E. Configure equipment requiring users to log on using a password with user/site-specific password/passwords.
- F. No system/product default passwords allowed
- G. No other wiring shall be run in the same conduit as access controls wiring.
- H. Any exposed conduit installed in public areas shall be painted to match the surrounding wall color.
- I. All conduit ends shall have a protective bushing to prevent cable damage. BUSHINGS MUST BE

INSTALLED PRIOR TO INSTALLING THE CABLE. CUTTING BUSHING TO INSTALL AROUND INSTALLED CABLES WILL NOT BE ACCEPTED.

3.3 WIRING

- A. The color code of all access control wiring shall be YELLOW in color. All access control cable shall be homerun from the card reader locations to the headend panel location typically located in local building MDF/IDF.)
 - 1. Approved Products: The following manufacturers or equivalent cable shall be acceptable. All cables shall be in a Yellow/composite construction, shielded, and must be yellow in color. NO EXCEPTIONS.
 - i. Access control, plenum, composite cable – 22/3PR_Card Reader, 18/4C_Lock power, 22/4_REX, 22/2_DC
 - 1. **Southwire P/N# - H91602**
 - 2. Belden is an approved alternative.
- B. Door Contact only doors.
 - 1. Yellow - 18 AWG, 4 conductor unshielded plenum rated cable constructed with stranded bare copper, polyvinylchloride insulation and an overall polyvinylchloride jacket for data communications/security applications manufactured in the USA and (UL) listed CL3P or CMP c(UL)us 75°C, FT-6.
- C. All cable shall bear the name of the approved manufacturer. NO PRIVATE LABELED CABLE WILL BE ACCEPTED
- D. Network Connection Cable: Provide a 4 pair Category 6A data cable from the Master Control Panels to the MDF/IDF network rack. Category 6A cable shall be YELLOW in color.
- E. The wire scheme and conductor quantity shall be as required by the device manufacturer's specifications. Contractor to provide and install shielded cable as required.
- F. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- G. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- H. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring
- I. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- J. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- K. All 120v Power shall be furnished by the Division 26 contractor. COORDINATE THE EXACT LOCATION WITH THE ELECTRICAL CONTRACTOR PRIOR TO THE ROUGH-IN.
- L. All Security Conduit as required for a complete installation of this system shall be furnished by the contractor as part of their scope of work. Conduit shall be minimum of 3/4 inch.

- M. Conduit shall be painted to match surrounding area where installed exposed to public view.
- N. Coordination with the Division 26 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- O. All systems shall be connected to a dedicated 120VAC circuit and to an emergency power source if available.
- P. All plenum wiring is to be installed parallel and perpendicular to the building structure. Install wiring tight up against structure for protection. Cable shall be bundled on a maximum of 2'-6" and secured to the structure at a maximum of 5' on center. Bundling and support shall be with plenum rated cable ties.
- Q. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed, to public view, or subject to physical damage.

3.4 CABLE PATHWAYS

- A. Cable Support:
 - 1. All wire not installed inside conduit, or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not within 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the j-hook support hook to the treaded rod.
 - 3. **Supports:** Nonconductive Plenum Rated Polypropylene J-hook cable support shall be installed at a maximum of 5' on center.
 - 4. **All cables installed shall be attached to the J-hook support system with plenum-rated Velcro, and a plenum-rated Velcro tie shall be installed between each Polypropylene J-hook cable support to keep wires neatly bundled throughout the entire run. Tie wraps will only be allowed inside the control panels as required to manage the wires within each panel type.**
 - 5. ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.
 - 6. IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO ENSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.

3.5 TESTING

- A. Security contractor is responsible for inputting all database information for initial installation and configuration of system for users that will be using the system at the

campus or administration building. Contractor shall coordinate names and locations of authorization on system with Owner once system is ready for demonstration.

- B. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- C. Provide instructions as to proper use and operation of the system, for the Owner's designated personnel.

3.5 CLOSEOUT SUBMITTALS

- A. Supply licensing and registration information for all software, hardware, firmware, operational, and administrative licenses.
- B. Supply network configuration backup files, restoration application and instructions
- D. System Support Resources:
 - 1. Submit a list of available manufacturers providing fee based professional services available to the Contractor or Owner, including but not limited to the following:
 - i. Training
 - ii. Installation
 - iii. Commissioning
 - iv. Remote diagnostics and integration with 3rd party software and hardware systems.
- E. Complete floor plan drawings locating all system devices and point to point wiring diagrams.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstration:
 - 1. Demonstrate administration and operation of access control system.
 - 2. Demonstrate how an authorized user can log in and make changes to configuration of card holders, door access, and run reports.
 - 3. Demonstrate how to operate functionality configured for this project as defined by configuration punch list.
- B. Fine Tuning:
 - 1. Perform field software changes after initial programming session to "fine tune" operating parameters and sequence of operations based on any revisions to Owner's operating requirements.
- C. License Assignment:
 - 1. Register software, hardware, firmware, operational or administrative licenses necessary for to operate or administer devices to Owner including the end user license agreement (EULA).
 - 2. Deliver to Owner's Representative proof of license registration from product manufacturer.
- D. Device Configuration Backup:
 - 1. Open path primarily uses the us-west-2 (Oregon) and us-east-1 (N. Virginia) AWS regions, with core customer data and daily backups managed in Amazon Aurora and encrypted and stored in multiple regions.
 - 2. Event and user data can be CSV exported via the Avigilon Alta Control Center, or via the open API.

3.6 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.
- B. Submit confirmation and details of manufacturer's warranty, extended warranty, and replacement policies.

3.7 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

END OF SECTION 28 13 00

SECTION 28 16 00 – INTRUSION DETECTION SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED WORK

- A. All Division 26 at relates to this section.

1.2 WORK INCLUDED

- A. The system shall include intrusion detection at every access point of the buildings, including but not limited to doors, roof hatches, windows and interior space motion detection. Card reader access interface must also be provided at locations noted.
 - 1. The Control System shall be the product of a single manufacturer.
 - 2. The system shall be portioned into 2 zones (kitchen and main building).
 - 3. Tag all conductors or cables at each end.
 - 4. Installation of security panels.
 - 5. Interconnection of security panels.
 - 6. Installation of new security devices.
 - 7. Full coverage of all windows, doors, roof hatches.
 - 8. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.
- B. The contractor shall connect this location to the district monitoring station as designated by the owner.
- C. Contractor shall integrate the Intrusion Detection system with the Access Control system and the Video Surveillance system. Provide all cabling, connectors and Bosch interface devices as required. Coordinate with other trades. Provide all licenses required.
- D. Contractor shall connect all back-up batteries per manufacturer's instructions.
- E. Contractor shall use a step-bit drill bit to install flush mount door contacts. Do not use a hole saw.

1.3 CODES AND STANDARDS

The system shall comply with the applicable Codes and Standards as follows:

- A. National Fire Protection Association Standards:
 - 1. NFPA 70 National Electric Code
 - 2. NFPA 72 National Fire Alarm Code
 - 3. NFPA 101 Life Safety Code
- B. Local & State Building Codes
- C. Requirements of Local Authorities having Jurisdiction
- D. Underwriters Laboratory Requirements and Listings for use in Security Alarm Systems.
- E. Requirements of American Disabilities Act (Public law 101-336).
- F. Texas Accessibility Standards (T.A.S.)

- G. State Fire Marshall.
- H. Texas Insurance Code.

1.4 QUALITY ASSURANCE

- A. Contractor Qualifications:
 - 1. The installing contractor shall be the authorized representative of the Intrusion Detection system to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the Intrusion Detection system manufacturer's product for at least two years.
 - 3. The installing contractor shall be licensed by the State of Texas as a security services contractor to design, sell, install, and service security alarm systems and access control system.
 - 4. The installing contractor shall provide 24-hour, 365 day per year emergency service with factory trained service technicians.
 - 5. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten (10) years.
 - 6. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the Bosch System. No person is allowed to work on the Bosch system without proper manufacturer's certification.
 - 7. Contractor shall have at least 5 years of experience installing, servicing and supporting Bosch Radionics Systems and have a local office within 75 miles of project site.

1.5 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
 - 1. Control panel wiring and interconnection schematics.
 - 2. Complete point to point wiring diagrams.
 - 3. Riser diagrams.
 - 4. Complete floor plan drawings locating all system devices.
 - 5. Factory data sheets on each piece of equipment proposed.
 - 6. Detailed system operational description. Any specification differences and deviations shall be clearly noted and marked.
 - 7. Complete system bill of material.
 - 8. Line by line specification review stating compliance or deviation.
- B. All submittal data will be in bound form with Contractor's name, supplier's name, project name, and state security license number adequately identified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

- A. BOSCH Security.

2.2 CONTROL COMMUNICATOR (Panel)

- A. The control communicator shall be Bosch model number B9512G with latest firmware upgrade. The unit shall be UL listed for commercial burglar alarm application and shall be FM approved.

1. The Intrusion Detection system shall be capable of being utilized as a combination Intrusion and Fire system per code. Fully integrated intrusion, access and fire functions allow users to interface with one system instead of three separate systems.
 2. Integrated Telephone Line Interface with programmable options for signaling and supervision.
 3. Conettix IP based communication option provides high-speed, secure alarm transport and control.
 4. 32 programmable areas with perimeter and interior partitioning.
 5. 8 on-board, class B hardwired points with expansion capability for a total of 246 wired or wireless points.
 6. Compatibility with touch-screen color LCD, vacuum fluorescent, ATM style LCD or LED style Alarm Command Centers.
 7. Local or remote programming, test, and diagnostic capability via a computer running the Remote Programming Software (RPS).
 8. The system shall support the use of an Apple iOS device for control. Functions to include arming, disarming, control of outputs, lock, unlock, cycle and secure access doors.
 9. Integrated real time clock, calendar, test timer and programmable scheduling capability for relay control and automatic execution of system functions based on a time / event.
 10. Provide 1.4 amps of power for standby operation and 2 amps of alarm power, both rated at 12 VDC.
 11. 2 wet-contact relay outputs and 1 Auxiliary wet-contact relay output with expansion capability for up to an additional 128 dry-contact relay outputs.
 12. Integrated battery charger with reverse hook up protection, battery supervision and battery deep discharge protection.
Supervision of peripheral devices and communications interface(s).
- B. Programmable features shall include:
1. Independently control zones through an independent zone control keypad.
 2. Two telephone number dial up for primary and secondary remote receivers.
 3. Automatic test reports.
 4. Selective zone shunting.
 5. Custom text on the associated command centers.
- C. Zone Expansion - Expanded to 246 individually annunciated points of protection through the addition of a two-wire multiplex zone expansion system (ZONEX). Points of protection are annunciated with custom text at the D1255B Alpha Command Center and they can be reported to a Bosch Connettix D6600 Receiver/Gateway.
- D. User Pass Codes – Nine Hundred ninety-nine (999) user pass codes shall be available to identify the user when arming/disarming the system.
- E. Protective Circuits shall consist of zones designed for fire and/or panic (holdup, duress, or emergency) and/or burglary and/or supervisory. Each zone represents a protective circuit and shall accommodate normally opened and closed devices with end-of-line resistor supervision. Each of the 246 points are programmable as to whether they are controlled versus 24 hours; interior versus perimeter; instant versus delayed; silent versus audible (and if audible, pulsed or steady); and local or reporting.
1. Additional programmable parameters for each point include the ability to suppress trouble or restoral reports, designate it as a priority zone (system cannot be armed if this point is off-normal), report two separate telephone numbers and provide for automatic shunting of points from the system in the event that the detection device malfunctions and creates numerous false alarms.
 2. Each POPIT shall accommodate normally opened and normally closed devices with

3. end-of-line resistor supervisor.
Minimum total points, 248.
- F. Entry/exit delays shall be independently programmable from 10 to 150 seconds. A pre-warn audible shall be coincident with the entry delay.
- G. Programming of all system functions shall be achievable at system site or remotely via the use of the dial-up telephone network. Minimum programmable functions shall include:
 1. User pass codes, entry/exit delay times, master zone personality, day/date/time, telephone numbers, point of protection text labels, and bell time.
 2. A programmable system pass code shall be used to prevent unauthorized remote programming attempts.
 3. Remote programming capability shall be automatic or require user enabling at the discretion of the user.
- H. Remote control via the use of the dial-up telephone and owners local area network shall include:
 1. System arming.
 2. Reset of audible signals.
 3. Activation/deactivation of relay contacts.
 4. Interrogation of battery.
 5. Zone and armed status.
 6. Enable/disable of reporting functions and removing reporting devices for servicing while the remainder of the system is operative.
- I. Recognitions shall include UL for central station fire and/or burglary, local burglary and/or fire; FM for fire, California Fire Marshal for fire; and NYBSA for fire.
- J. Miscellaneous built-in features shall include:
 1. Real-time clock.
 2. Interrogator.
 3. Auto-answer modem.
 4. Phone line monitor.
 5. Loop start/ground start telephone interface.
 6. Auto bell test.
 7. Lug-in terminal strips, and user-controlled zone bypass.
- K. Command center (arm/disarm keypad) shall be microprocessor-based, UL listed, with built in: Model B930 ATM Style Alphanumeric Keypad (SDI2)
 1. Provide clear, polycarbonate cover at each location.
- L. Modules and Accessories
 1. ZONEX (Zone Expansion D8125, D8126)
 2. D8132 Battery charger module
 3. D8103 Universal enclosure
 4. D8129 Octo-Relay module - provides eight form "C" dry contact relay outputs for a variety of programmable responses to alarm, trouble and other system conditions. They shall be automatically operated through schedules.
 5. Auxiliary power supplies as required for powering of motion detectors.
 6. DX4020 Network Interface module 1ea required.
 7. D928 Dual Phone Line switcher.
- M. Contractor shall provide the following devices for attic stock for the Intrusion Detection System that is installed. Contractor shall confirm and Coordinate manufacturer and model number of equipment installed:

1. 1 qty. Bosch Intrusion panel – model B9512G
2. 1 qty. Bosch Command Center (KP) – model B930

2.3 FIELD DEVICES

- A. Ceiling mounted, 360-degree dual technology, infrared sensors/microwave motion sensors. Model DS9370
 1. Bracket for direct mounting to standard 3-1/2" and 4" electrical backboxes.
 2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
 3. Contractor to provide a dedicated POPIT for each motion detector on the project.
- B. Wall mounted, high performance, TriTech PIR/Microwave sensor, Model DS970.
 1. Low Profile Bracket for directional mounting to standard 3-1/2" and 4" electrical backboxes.
 2. All units to have areas of coverage, which would cause false alarm signals to be generated, masked out and adjusted to reduce false signals.
 3. Provide in gymnasiums/cafeteria wall mounted areas. Provide protective wire cover in gymnasium areas.
 4. Contractor to provide a dedicated POPIT for each motion detector on the project.
- C. Magnetic Door/Hatch Contacts
 1. Door contacts shall be provided by Access Control Contractor. Div 28 13 00

2.4 WIRING

- A. All wiring shall be per the manufacture's specifications. All cable shall be shielded as required.
- B. All 120v Power shall be furnished by the Division 26 contractor.
- C. All Security Conduit as show on the drawings shall be furnished by the Division 26 contractor as part of there scope of work.
- D. Coordination with the Division 26 contractor is the responsibility of the Security Contractor to ensure all conduit is in place for a complete installation.
- E. All systems shall be connected to an emergency power source as available.
- F. Color code of all security intrusion detection system and access control wiring shall be purple in color.

Approved Products:

 1. 18/2 unshielded:
Belden #6300UE 0071000
Tappan Wire & Cable, Inc. #P40020.122
 2. 18/4 unshielded:
Belden #6302UE 0071000
Tappan Wire & Cable, Inc. #P41387.28
 3. Provide 18/6 cable as required: Belden or Tappan.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
- E. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
- F. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- G. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
- H. Telephone Cable: Provide a 4 pair Category 5E telephone cable from the Master Control Panel to the Telephone Equipment Room.
- I. Each motion sensor is to be connected into a dedicated POPIT module for point identification.
- J. Each set of magnetic door contacts that protect one room are to be connected through one POPIT module for point identification of that room.
- K. Magnetic door contacts protecting separate hallways or entry areas to be connected into separate POPIT modules for separate identification.
- L. **Provide and install (1) dedicate POPIT for each new device installed on the project. Including, but not limited to glass break detectors.**
- M. All POPIT Modules shall be installed inside a 4"x4" junction box with a cover. Junction box shall be mounted on the wall nearest to the device the POPIT Module is associated with and the module shall be mounted to the mounted to the back box at each location.
- N. Integrate the security system to the remote monitoring station. Provide all hardware and cabling as required. Coordinate with Owner for approved remote monitoring service.
- O. All popits on project shall be mounted above ceiling in easily accessible area. All popit modules are required to be located on as-built drawings delivered to owner at completion of project.
- P. All keypads and sirens shall have dedicated wiring homeruns from each keypad or siren back to panel. Do not daisy chain keypads or sirens.

- Q. Contractor shall install communication wire from freezer/cooler control panels to burglar alarm panel to notify panel should freezer/cooler encounter high temperature condition. Coordinate programming and final terminations with Owner.

3.2 CABLE PATHWAYS

A. Cable Support:

1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - a. Approved Cable Support Product:
PANDUIT® Corporation J-MOD™ modular support system (sized appropriately for the number of wires being installed. Reference the manufacturer's specifications for the suggested maximum cables per support size.)
2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the fire alarm panels as required to manage the wires within each type of panel.
5. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
6. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.**

B. Conduit / Raceway:

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.

3.3 SYSTEM OPERATION

- A. When an alarm condition is detected by any of the alarm initiating devices, the following functions shall occur:
1. The system keypad's interior audible device shall sound until silenced by using proper security code or after system time out.
 2. A custom system alarm message shall be displayed on the LCD display. This

display will show the alarm device location in plain English. Location and partition custom messages shall be field programmable.

3. The remote signaling tie connection shall be activated at the Owner's approved central security monitoring location and/or other Owner designated location.
4. Printer shall provide printed copy of events recorded in logger. Install adjacent to security panel.

3.4 SYSTEM ZONING AND PARTITIONING

- A. The system shall employ intelligent initiating devices and interface devices capable of being recognized and enunciated at the main system keypad and devices partition keypad.
- B. All zoning/device locations shall be field programmable.
- C. Input control zones include but are not limited to the following:
 1. Elementary and Junior High Schools
 - a. Kitchen
 - b. Main school areas

3.5 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.6 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.7 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

END OF SECTION

SECTION 28 23 00 - VIDEO SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. This section identifies the requirements, technical design, and specifications of a cloud-hosted video surveillance system consisting of cloud-connected cameras and sensors for Huffman ISD located in Huffman, Texas ("Owner"). The video surveillance system as specified is an industry-standard and includes network video recorder(s)/server(s), software, licenses, cameras, mounts, cabling and video system programming as specified.
- B. Provide a complete and tested fully networked IP based digital video surveillance system including cameras, cabling, digital image storage, integration and accessibility with Owner's Local/Wide Area Network (LAN/WAN), Internet accessibility thru remote view application software and simultaneous user access capability. The installation shall comply with applicable codes and standards in effect at the job site and as indicated in the Specifications and Drawings.
- C. The system shall be Non-Proprietary in nature and be available through multiple distribution channels in the Houston Marketplace. System that are manufactured and installed by a factory office and are not available through multiple distribution channels will not be accepted.
- D. Provide all electronic hardware and coordinate with the building's LAN/WAN. The contractor shall coordinate with other system vendors, where appropriate, to facilitate equipment installation, scheduling, protection of equipment and access to the project site to provide the Owner a substantially complete project in a timely manner. HISD will assign computer names, and all IP addresses for each system.
- E. Provide all licensing and software required for a turnkey installation for all devices shown on the drawings and within this specification.
- F. The contractor shall integrate the Video Surveillance system with the Access Control system. Coordinate with other trades. Provide all licenses required.
- G. It is the Contractor's responsibility to review this specification and associated project specifications and drawings in their entirety, prior to bidding on the project. By bidding on this project, the contractor acknowledges that they have read and fully understand these specifications, with no exceptions. The contractor shall review the drawings, specifications, and existing conditions prior to bidding on the project. Any discrepancies shall be brought to the attention of the architect/Design Consultant via request for information (RFI) in writing for evaluation and or clarification. If these items are not brought to the attention of the architect/Design Consultant the more costly or difficult manner, and the better quality or greater quantity of work shall be provided by the contractor in accordance with the architect's/Design Consultant's interpretation at no additional cost to the owner. Contractor shall verify the installation methodology of each device location prior to proceeding with installation. Potential obstructions or mounting conflicts due to changing conditions shall be identified via written RFI for approval with the Owner / Architect / Design Consultant.
- H. Contractor shall furnish and install all materials, equipment, and labor necessary to provide a complete and functional turn-key Video Surveillance system regardless of any items not listed or described in this specification or associated drawings.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. The Video Surveillance System Installer shall be licensed and shall meet all applicable regulations. The Contractor shall be a firm normally employed in the installation of Digital Video Surveillance Equipment.
 - 2. The contractor shall be certified by the manufacturer in all aspects of design, installation and testing of the products described herein. Each contractor shall furnish with their proposal a letter from the manufacturer indicating they are a dealer in good standing.
 - 3. The contractor must be certified by the manufacturer of the products, adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels.
 - 4. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size. The contractor shall own and maintain tools and equipment necessary for successful installation and testing of video surveillance distribution systems and have personnel who are adequately trained in the use of such tools and equipment.
 - 5. The installing contractor must have a permanent office within a 75-mile radius of the project site and be an approved dealer/integrator of the proposed system, in the nearest major metropolitan area.
 - 6. The proposing contractor and the installing contractor must be the same company.
 - 7. A resume of qualifications shall be submitted with the Contractor's proposal indicating the following:
 - a. A list of five recently completed projects using the product proposed of similar type and size with contact names and telephone numbers for each.
 - b. A list of test equipment proposed for use in verifying the installed integrity of metallic cable systems on this project.
 - c. A technical resume of experience for the contractor's Project Manager and on-site installation supervisor who shall be assigned to this project.
 - d. A list of technical product training attended by the contractor's personnel that shall install the video surveillance system shall be submitted.
 - e. Any subcontractor who shall assist the video surveillance contractor in performance of this work shall have the same training and certification as the video surveillance contractor.
- B. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 01 apply to the work specified in Division 28 and shall be complied with in every respect. The Contractor shall examine all the items which make up the Contract Documents and shall coordinate them with the work on the project.

1.3 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
 - 1. Local Building Code
 - 2. Local Electrical Code
 - 3. NEC National Electrical Code
- B. Other references:
 - 1. TIA/EIA-568-A - Commercial Building Telecommunications Wiring Standard

2. EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
 3. TIA/EIA-606 - The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 4. TIA/EIA-607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
 5. TIA/EIA TSB 67 - Transmission Performance Specification for Field Testing of Unshielded Twisted-Pair Cabling Systems.
 6. ISO/IEC 11801 - Generic Cabling Standard
 7. EN 50173 - Generic Cabling Standards for Customer Premises
- C. Governing Codes and Conflicts:
1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes, regulations, and manufacturer installation requirements.

1.4 SUBMITTALS

- A. The video surveillance system installer shall furnish the following in a single consolidated submittal:
1. Permits: The Contractor shall obtain all required permits and provide copies to the Owner/Architect/Engineer
 2. Product Literature: Complete manufacturer's product literature for all electronics, cable, cable supports, cable labels, outlet devices, and other products to be used in the installation. In addition, whenever substitutions for recommended products are made, samples (when requested by the Owner/Architect/Engineer) and the manufacturer's supporting documentation demonstrating compatibility with other related products shall be included.
 3. Testing: Proposed Contractor test result forms, a list of instrumentation to be used for systems testing.
 4. Specification Compliance: A letter shall be provided stating, by section and subsection, that the intercom system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of the reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- B. Certifications/Licensing: The contractor shall submit all of the following certifications/licensing, and all must contain dates which are valid from the date of proposal and not expired any sooner than 12 months after substantial completion of the project.
1. State Licenses as applicable to this system
 2. Manufacturer's Authorized Dealer Certification
 3. Manufacture Installer Training Certificate (required for at least 25% of all installers on site.)
- C. Shop Drawings: Submit the following items, for Owner review and approval:
1. Proposed cable routing and power circuit grouping plan.
 2. In addition to the above listed items, the submitted drawings shall show the following:
 - a. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - b. Location of sleeved wall pass-thru
 - c. Size of sleeve at each location installed

- d. Quantity of cable passing through each sleeve
 - 3. Conformance: For items which are being provided exactly as specified, provide a letter stating the item description and model number, and that it is being provided as specified.
 - 4. Drawing Compliance: A letter shall be provided stating that the Access Control system installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of the reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- D. Closeout Submittals
- 1. Final payment of the contractor will not be authorized until the complete documentation specified herein is delivered to the owner. 10% retainage of the entire project will be withheld until receipt of this information.
 - 2. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion.
 - b. Include the Name, address and telephone number of the authorized factory representative with a 24-hour emergency service number.
 - c. The manual shall also include the Manufacturer's data sheets and installation manuals/instructions for all equipment installed a list of recommended spare parts.
 - d. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - e. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each and every change made to the security camera system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the Security Camera System equipment as well as raceway size and routing, junction boxes, and conductor size, quantity, and color in each raceway.
 - f. As-built Drawings shall include cable pathways, camera locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCAD 2019 or later. Provide the Owner with electronic versions of the as-builts on 2 qty. 8MB thumb drives.
 - g. All drawings must reflect point to point wiring, device address and programmed characteristics as verified in the presence of the engineer and/or the end user unless device addressing is electronically generated, and automatically graphically self-documented by the system.
 - h. A hard copy printout of the system software database and an electronic version (on disk or CD) of the system program and database with all required passwords, as installed at the time of acceptance by the owner.
 - i. A copy of the manufacturer's warranty on the installed system.
 - j. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.

- k. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during the course of construction, and shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. (4 copies)
- l. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. The minimum amount of training time shall be at least 4 hours.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. The following sections specifically list the acceptable equipment types and items for this project.
- B. All software, hardware, and equipment (from the date of RFP) shall be tested, currently available and commercially off the shelf product. (COTS).
- C. All wiring, equipment, and installation materials shall be Commercial Grade, new, and of the highest quality to meet or exceed the performance and features of the equipment and devices specified herein.
- D. All devices shall be installed with the manufacturer recommended mounts and accessories as necessary for the installation locations type as scheduled.
- E. Unless otherwise stated, all software and licensing shall be for the most current, up to date version of the system provided. For existing systems, Contractor shall obtain written verification of the Owner's most current software version and notify via RFI the Architect / Design Consultant / Owner if implementation of the most current software / license version will require an upgrade to the Owner's existing system.
- F. Architect / Design Consultant / Owner will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.
- G. In the event a manufacturer's specified product or part number has changed or is no longer available, Contractor shall submit a formal RFI for an appropriate substitute.
- H. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished at no additional cost to the owner.
- I. Labels on all cabling, materials, and equipment must indicate a nationally recognized testing laboratory.
- J. The contractor shall review all products specified and required for this project to determine if there are any lead times for any products that may cause any delay. The contractor shall clearly identify any concerns with lead times in writing to the Architect / Design Consultant / Owner. If the Contractor does not identify any concerns with products having long lead times, it will be understood there are no long lead time issues, and the Contractor will have all products on-site when needed to complete the job as per the project schedule.
- K. Any quantities listed are for reference only, contractor is responsible for furnishing materials as required to provide a fully functional turkey system. Where quantities are not noted, Contractor shall refer to drawings and schedules to determine exact quantities.
- L. Video Surveillance System Cabling
 - 1. By Division 27 10 00
 - 2. Pathway Cable Support installed by others
- M. Surge Protection
 - 1. Provide surge suppression for any exterior cameras connecting back into central network system.
- N. Camera updated to latest stable release of firmware.
- O. Configure IP Address with provided static IP, Subnet and Gateway. (Provided by HISD)
- P. Each camera to have a unique password. (Provided by HISD)
- Q. The contractor shall connect all back-up batteries per manufacturer's instructions.

- R. The contractor shall provide new acoustic ceiling tiles that match existing ceiling tiles where existing cameras have been removed.
- S. Coordinate with Owner regarding camera network configuration and estimated bandwidth utilization prior to connection of cameras to Owner's network.
- T. Labeling
 - 1. Permanent Labels for Copper Cables
 - 2. Panduit Self-Laminating Labels
 - 3. Or approved equal.
- U. Fire Stop
 - 1. STI Spec Seal
 - 2. 3M Products
 - 3. Or approved equal.

2.2 SYSTEM REQUIREMENTS

- A. The video surveillance system shall be a cloud-hosted video management system (VMS), including network-based cloud-connected cameras with native onboard storage.
- B. **All videos shall be stored for a minimum of 30 days unless directed otherwise by the owner.** The contractor shall ensure that adequate storage / server capacity and quantity is provided to accommodate the number of camera views for each campus to retain 30 days of storage. 72 hours centralized storage at the district NOC and the remaining storage shall be cloud based to achieve a full 30 days minimum of storage.

2.3 MANUFACTURERS

- A. Basis of Design: Avigilon Alta Video
 - 1. Address: 500 W Monroe Street, Ste 4400, Chicago, IL 60661, USA.
 - 2. Phone: +1 (888) 281-5182
 - 3. Website: www.motorolasolutions.com
- B. Manufacturer List:
 - 1. Motorola Solutions, Inc
- C. Source Restrictions: Supplier to provide a fully integrated cloud-hosted surveillance system consisting of fixed position and movable network cameras and the following components obtained from a single source and provided by a single manufacturer:
 - 1. Cloud-Hosted Video Management System
 - 2. Cloud Connected Video Surveillance Cameras
 - 3. Cloud Connector Appliance for non-cloud cameras
 - 4. Video Surveillance Sensors

2.4 CLOUD HOSTED VIDEO MANAGEMENT SOFTWARE SYSTEM

- A. Basis of Design Product: Avigilon Alta Aware.
- B. General: Provide Cloud-Hosted Video Management software that allows the following functionality:
 - 1. VMS Software that is fully hosted in the cloud.
 - 2. Provides access to the following camera types:
 - a. Cloud Connected Cameras
 - b. Cameras record locally and send to the cloud on a defined schedule.
 - c. Third Party Cameras connected to a Cloud Connector Appliance.
 - 3. The VMS shall include a simplified layout, intuitive controls, and customizable features that support multi-person interactions and include the following:
 - a. Video analytics from all connected cameras to identify objects and events, based on pre-determined rules and unusual activity detection.

- b. Instant notification and alarms via text/email.
 - c. Allows monitoring of live and recorded video over wireless IP networks from Apple or Android mobile devices.
 - d. Support up to 16 total camera views within a single layout, and concurrently run multiple instances of VMS in separate tabs within same web browser without logging user out.
 - e. Enables viewing access control events directly in a camera view.
 - f. Enabling of people counting, vehicle counting, intrusion detection, and forensic investigation.
 - g. Employing AI to self-learn, enabling progressively more accurate analytic results over time.
- C. System: Provide a scalable cloud-hosted VMS solution with the following capabilities:
- 1. Compression types supported: H.265, H.264, MJPEG, JPEG2000
 - 2. The VMS shall support IP cameras and encoders from third party manufacturers in addition to their own products.
 - 3. The VMS shall discover IP cameras and encoders automatically.
 - 4. Camera capacity:
 - a. Per server: 16-200
 - b. Per site: unlimited
 - 5. The VMS shall provide dynamic stream selection.

2.5 VIDEO MANAGEMENT SOFTWARE FUNCTIONALITY

- A. General: Provide a cloud-hosted VMS application that can be logged into from any web-browser (Chrome, Microsoft Edge, etc.) with a username and password.
- 1. The VMS shall also support two factor authentication via an authenticator app (such as Google Authenticator or Microsoft Authenticator) and allow the system administrator to enable corporate account single-sign on for the deployment.
- B. Dashboard: Provide an intuitive dashboard upon user login that displays tools based on user access level. Dashboard shall display the following:
- 1. Video view
 - 2. Map view
 - 3. Devices
 - 4. Search
 - 5. Rules
 - 6. Appliances
 - 7. Users
 - 8. Alarms
 - 9. Counts
 - 10. Saved Clips
- C. Video View: Provide an intuitive interface where user can choose their layout from a pre-defined number of tiles that can display up to 16 camera streams at one time.
- 1. User shall be able to populate each view by selecting and dragging individual cameras, camera groups, or all cameras associated to a site.
 - 2. Each individual viewing tile shall be able to switch between live or recorded video.
 - 3. Video View interface shall support automatic rotation configuration, and the ability to set up custom rotations. Once rotation is set, VMS shall automatically display Analytic or high priority rule triggers automatically within the Video view pane.
 - 4. Video View shall be capable of enabling additional information as graphic layers within each tile and showing the following:
 - 5. Timeline
 - 6. Vehicle Bounding Boxes
 - 7. People Bounding Boxes

8. Object Counts
9. Access Control Information
10. Cloud Storage Usage
11. License Plate Data
12. Sound Equalizer
13. Audio Levels
- D. Map View: Support mapping of physical locations of cameras and other devices throughout VMS.
 1. Provide maps with the ability to do the following:
 - a. Upload site maps to view
 - b. Add single and room walls within site map
 - c. Add cameras and other devices onto map by dragging to representative position
 - d. Set camera fields of view
 - e. Link site maps and additional information markers
 - f. Display object types and counting for vehicles and people
 - g. Add integrated access control points
 - h. Remotely unlock access control points
 - i. Enable heatmap information
 2. Map view shall display and track different object types as they move through linked cameras in real time.
 - a. User shall be able to click on person or vehicle icons to view video stream from selected camera.
- E. Devices Tool: VMS shall provide a centralized device administration tool capable of displaying all connected cameras, access control points, sensors, and IP speakers at all sites in one location.
 1. From the Device Tool the user shall be able to do the following:
 - a. Search for cameras and other devices (access control points, sensors, etc.) visible to VMS.
 - b. An advanced search feature can be enabled to filter results based on user selected category.
 - c. Edit the information for existing cameras and devices.
 - d. Add new cameras and devices into VMS.
 - e. Show/hide a thumbnail view for each camera.
 - f. Set up configuration profiles that can define resolution, recording mode and retention policy.
 - g. Set up anomaly detection settings for cameras.
 - h. Define credentials to be applied to cameras used in VMS.
 - i. Define device groups to use when assigning cameras.
 - j. Show the devices tool in full-screen mode.
 - k. Enable audio announcements.

2.6 VIDEO MANAGEMENT FORENSIC SEARCH FUNCTIONALITY

- A. The VMS shall facilitate forensic or other investigation by provisioning the following search functions:
 1. Similarity
 2. Physical characteristics
 3. Event
 4. Individual image
 5. Timeline with embedded thumbnail images
 6. All video
- B. Face Searching (extra license)
 1. Ability to search to look for video footage of a specific face via uploaded image.

- C. Searching must allow for the sharing of results via a secured cloud link.
 - 1. Sharing an unlimited amount of external video links from multiple cameras that include password encryption.

2.7 VIDEO MANAGEMENT CYBER SECURITY FUNCTIONALITY

- A. Cloud
 - 1. Cloud connectivity will only be possible through HTTPS (port 443).
 - 2. All connections to the cloud shall be outbound and require no ports be opened for inbound communication to support the VMS application.
 - 3. Each cloud deployment shall be a fully independent instance, fully isolated and protected from other deployments.
 - 4. Users shall have full control over the system maintenance window.
- B. Streaming
 - 1. Video streaming shall be controlled via RTSP operating over TLS.
 - 2. SRTP shall be used to provide encryption, message authentication and integrity of the streaming video.
 - 3. The cloud system shall be architected so that latency and bandwidth consumption are minimized, as is the involvement of the Manufacturer-operated cloud.
- C. Encryption
 - 1. Video shall be encrypted using AES.
 - 2. All recordings and metadata shall be encrypted at rest in both the cloud and the camera.
- D. Tampering detection shall be provided through the digital watermarking of video.

2.8 3RD PARTY INTEGRATIONS

- A. Access Control
 - 1. Alta Access (formerly OpenPath)
- B. Identity Providers
 - 1. Azure-AD
 - 2. Google
 - 3. OKTA
 - 4. ADFS

2.9 MOBILE APPLICATION

- A. VMS must have an available mobile app for both Apple App Store and Google Play Store.
- B. Mobile application must offer the following features:
 - 1. Remote viewing of live and recorded video.
 - 2. Remote access to audio recording.
 - 3. Access to alarms on mobile.
 - 4. Ability to add cameras to Cloud VMS via QR code on mobile app.
 - 5. Ability to do similarity searching.

2.10 CAMERAS

- A. Acceptable Manufacturers
 - 1. Avigilon Alta
 - 2. ONVIF Cameras connected to Avigilon Alta Cloud Connector
- B. Performance Requirements for all camera types:
 - 1. Provide a five (5) year Avigilon Alta Aware Cloud Subscription License per camera.

2. Camera firmware updates for cloud-connected cameras shall be automatically managed from the cloud.
3. The camera shall have factory-installed certificates, backed by a Trusted Platform Module (TPM 2.0) and unique encryption keys.
4. The camera shall have no default passwords.
5. Access authentication shall be mandatory.
6. Encryption: via HTTPS and TLS.
7. Connectivity: 802.3ab 10/100/1000 BASE-TX Gigabit Ethernet
8. Protocols supported:
 - a. Security: Transport Layer Security (TLS)
9. Local SD storage
 - a. Up to 2x Micro SD, SDXC UHS-1 card
 - b. 30 days onboard storage
10. Warranty: up to 10 years with Alta Aware license, 3 years without.

C. Camera Types:

1. CLOUD-HOSTED DOME CAMERA (ON-PREMISE & CLOUD-NATIVE)

(Type 1 on Drawings)

Interior Model Number – 5.0C-H6SL-D1-IR

Exterior Model Number – 5.0C-H6SL-DO1-IR

- a. The Cloud-Hosted Dome Camera shall be the Avigilon Alta H6SL Dome Camera. The camera shall be an indoor/outdoor network dome camera with 5 MP image resolution, equipped with Artificial Intelligence (AI) and audio analytics, and with the option for wide angle or telephoto lenses.
- b. Image Sensor:
 - 1) Size: 1/2.8" progressive scan CMOS
 - 2) Resolution: 5 MP
 - 3) Aspect Ratio:
 - a) 5 MP: 4:3
- c. Dynamic Range:
 - 1) 5 MP: HDR Off: 83 dB; HDR On: 130 dB
- d. Maximum Streaming Resolutions:
 - 1) 5 MP: 2592 x 1944 pixels
- e. Lens:
 - 1) 3.4 – 10.5 mm
 - a) Maximum IR illumination range: with high power 850 nm LEDs
 - (1) 5 MP:
 - (2) 30 m (100') full tele
 - (3) 20 m (65') full wide
 - b) Minimum illumination:
 - (1) 5 MP:
 - (2) With IR: 0 lux in monochrome mode
 - (3) Without IR: 0.01 lux in color mode
 - (4) 0.005 lux in monochrome mode
 - c) Horizontal Field of View:
 - (1) 5 MP: 95° - 28°
 - d) Vertical Field of View:
 - (1) 5 MP: 69° - 21°
 - (2) Max Aperture: f/1.6

- f. Video:
 - 1) Compression type: H.264, MJPEG
 - 2) Electronic Shutter Control: Automatic
 - 3) Day/Night Control: Automatic
 - 4) Flicker Control: 50-60 Hz
 - 5) Iris Control: P-Iris
 - 6) White Balance: Automatic
 - 7) Image Rotation: 0°, 90°, 180°, 270° including Corridor Mode
 - 8) Privacy Zones: up to 64 zones
- g. Network:
 - 1) Type: 100 BASE-TX
 - 2) Cabling Type: minimum Cat-5
 - 3) Connector: RJ-45
 - 4) ONVIF: Profile S, T, G, M compliant
 - 5) Protocols: IPv6, IPv4, HTTP, HTTPS, SOAP, DNS, NTP, RTSP, RTCP, RTP, TCP, UDP, IGMP, ICMP, DHCP, ARP, HSTS
 - 6) Streaming Protocols: WebRTC, RTP/RTSP/UDP, RTP/RTSP/TCP, RTP/RTSP/HTTP/TCP, RTP/RTSP/HTTPS/TCP
 - 7) VMS Platform Compatibility: Avigilon Alta Aware, Avigilon Unity/ACC, 3rd-party VMS (must run Unity firmware)
- h. Auxiliary I/O:
 - 1) Audio Compression Method: G.711 PCM 8kHz, Opus
 - 2) Audio Input/Output: Line Level I/O
 - 3) External I/O Terminals: Alarm In/Alarm Out
- i. Mechanical:
 - 1) Dimensions: D x H
 - a) Surface Mount: 156 mm x 116 mm (6.1" x 4.6")
 - b) In-Ceiling Mount: 174 mm x 165 mm (6.9" x 6.5")
 - c) Pendant Mount: 156 mm x 116 mm (6.1" x 4.6")
 - 2) Weight:
 - a) Surface Mount: 0.81 kg (1.78 lbs)
 - b) In-Ceiling Mount: 0.81 kg (1.76 lbs)
 - c) Pendant Mount: 1.07 kg (2.35 lbs)
 - 3) Construction Material:
 - (1) Dome Bubble, Body & Housing: polycarbonate
 - 4) Finish: plastic, injection molded, Pantone 427C.
- j. Electrical
 - 1) Power Source: PoE IEEE 802.3af Class 3 compliant, 12 VDC Aux
 - 2) IR Illuminator:
 - a) Turns off if temperature is 60°C (140°F) or higher.
 - b) Will operate at 50% power if the temperature is between 40°C (104°F) and 52°C (117°F).
 - c) Hysteresis: 2°C (3.6°F).
 - 3) RTC Battery Backup: 3V manganese lithium.
 - 4) PoE: 10 W max (8 W with no IR or IR disabled).
 - 5) Memory: 1 GB RAM, 512 MB flash
- k. Environmental:
 - 1) Operating Temperature:
 - a) Indoor Dome: -10°C - 60°C (-14°F - 140°F)
 - b) Outdoor Dome: -40°C - 60°C (-40°F - 140°F)
 - 2) Storage Temperature:

- a) Indoor Dome: -10°C - 70°C (-14°F - 158°F)
- b) Outdoor Dome: -10°C - 70°C (14°F - 158°F)
- 3) Humidity: 0 – 95% non-condensing
- I. Analytic Rules Supported:
 - 1) Objects in Area
 - 2) Object Loitering
 - 3) Objects Crossing Line
 - 4) Object Counting
 - 5) Object Line Crossing Counting
 - 6) License Plate Detection
 - 7) Audio
 - a) Glass Break
 - b) Loud Noise
 - c) Gun Shot
 - d) Screaming
 - e) Smoke Alarm
 - f) Car Alarm
 - g) Ultrasound Panic Alarm
 - h) Dog Barking
 - i) Tire Screeching

2. CLOUD-HOSTED 360° CAMERA

(Type 2 on Drawings)

Interior Model Number – 360-W-30

- a. The Cloud-Hosted 360° camera shall be the cloud-native Avigilon Ava 360 Camera. The camera shall be an indoor/outdoor network dome camera with up to 12 MP (9 MP effective) image resolution, equipped with Artificial Intelligence (AI) and audio analytics, and with the option for built-in retention for cloud operation.
- b. Image Sensor:
 - 1) Size: 1/2.3"
 - 2) Resolution: 12 MP, 9 MP effective
- c. Lens:
 - 1) Fixed Focus
 - 2) Aperture: f/2.0
 - 3) Focal Length: 0.5 - infinite
 - 4) Field of view: >180°
 - 5) Automatic Night Mode
 - 6) IR cut filter
 - 7) IR Range: 20m
 - 8) 850 nm IR LED
- d. Video:
 - 1) Compression type: H.264, MJPEG
 - 2) Maximum resolution: up to 3008 x 3008 pixels
 - 3) Frame rate: up to 30 fps
 - 4) Dynamic range: multi-exposure line-based HDR
 - 5) The camera shall provide AI-based video analytics to include people and vehicle presence.
- e. Cloud:
 - 1) All upgrades shall be automatically managed from the cloud.

- f. Electrical:
 - 1) Power Input: IEEE 802.at PoE+, Type 2
 - 2) Power Consumption:
 - a) Typical: 5 W
 - b) Without heater: 13 W
 - c) With heater: 23 W
- g. Mechanical and Environmental:
 - 1) Construction material: Aluminum; thermo-plastic bubble.
 - 2) Finish options: white, black.
 - 3) Impact resistance: IK10
 - 4) Dimensions (D x H): 152 mm x 152 mm x 77 mm (6.0" x 6.0" x 3.0").
 - 5) Weight: 1.1kg (2.4 lbs)
- h. Temperature:
 - 1) Operating: -40°C to 50°C (-40°F to 122°F).
 - 2) Storage: -40°C to 60°C (-40°F to 140°F).
- i. Ingress protection: IP66
- j. Mounting Box Options:
 - 1) Octagon
 - 2) 4" square
 - 3) Single or double gang
 - 4) EU ceiling or outlet box
- k. Mounting Options:
 - 1) Pendant mounting cap in white, black.
 - 2) Wall arm mount in white, black.
 - 3) Pendant head in white.
 - 4) Pendant pipe, 40 cm ((15.75") in white.
 - 5) Pole bracket in white, black.
 - 6) Corner bracket in white, black.
 - 7) Conduit adapter, 20 mm (3/4") in white, black.
- l. Storage:
 - 1) microSD
 - 2) SDXC UHS-1 card

3. CLOUD-HOSTED BULLET CAMERA (ON-PREMISE & CLOUD-NATIVE)

3.4 - 10.5mm Lens – 5.0C-H6SL-BO1-IR (Type 3 on Drawings)

10.9 - 29mm Lens – 5.0C-H6SL-BO2-IR (Type 4 on Drawings)

- a. The Cloud-Hosted Bullet Camera shall be the Avigilon Alta H6SL Bullet Camera. The camera shall be an indoor/outdoor network bullet camera with 5 MP image resolution, equipped with Artificial Intelligence (AI) and audio analytics, and with the option for wide angle or telephoto lenses.
- b. Image Sensor:
 - 1) Size: 1/2.8" progressive scan CMOS
 - 2) Resolution: 5 MP
- c. Aspect Ratio:
 - 1) 5 MP: 4:3
- d. Dynamic Range:
 - 1) 5 MP: HDR Off: 83 dB; HDR On: 130 dB
- e. Maximum Streaming Resolutions:
 - 1) 5 MP: 2592 x 1944 pixels
- f. Lens:
 - 1) 3.4 – 10.5 mm

- a) Maximum IR illumination range: with high power 850 nm LEDs
 - (1) 5 MP:
 - (2) 40 m (131') full tele
 - (3) 20 m (65') full wide
- b) Minimum illumination:
 - (1) 5 MP:
 - (2) With IR: 0 lux in monochrome mode
 - (3) Without IR: 0.04 lux in color mode
 - (4) 0.02 lux in monochrome mode
- c) Horizontal Field of View:
 - (1) 5 MP: 95° - 28°
- d) Vertical Field of View:
 - (1) 5 MP: 69° - 21°
 - (2) Max Aperture: f/1.6
- 2) 10.9 – 29 mm
 - a) Maximum IR illumination range: with high power 850 nm LEDs
 - (1) 5 MP:
 - (2) 70 m (230') full tele
 - (3) 30 m (100') full wide
 - b) Minimum illumination:
 - (1) 5 MP:
 - (2) With IR: 0 lux in monochrome mode
 - (3) Without IR: 0.04 lux in color mode
 - (4) 0.02 lux in monochrome mode
 - c) Horizontal Field of View:
 - (1) 5 MP: 28° - 10°
 - d) Vertical Field of View:
 - (1) 5 MP: 21° - 7°
 - (2) Max Aperture: f/1.6
- g. Video:
 - 1) Compression type: H.264, MJPEG
 - 2) Electronic Shutter Control: Automatic
 - 3) Day/Night Control: Automatic
 - 4) Flicker Control: 50-60 Hz
 - 5) Iris Control: P-Iris
 - 6) White Balance: Automatic
 - 7) Image Rotation: 0°, 90°, 180°, 270° including Corridor Mode
 - 8) Privacy Zones: up to 64 zones
- h. Network:
 - 1) Type: 100 BASE-TX
 - 2) Cabling Type: 6A
 - 3) Connector: RJ-45
 - 4) ONVIF: Profile S, T, G, M compliant
 - 5) Protocols: IPv6, IPv4, HTTP, HTTPS, SOAP, DNS, NTP, RTSP, RTCP, RTP, TCP, UDP, IGMP, ICMP, DHCP, ARP, HSTS
 - 6) Streaming Protocols: WebRTC, RTP/RTSP/UDP, RTP/RTSP/TCP, RTP/RTSP/HTTP/TCP, RTP/RTSP/HTTPS/TCP
 - 7) VMS Platform Compatibility: Avigilon Alta Aware, Avigilon Unity/ACC, 3rd-party VMS (must run Unity firmware)
- i. Auxiliary I/O:
 - 1) Audio Compression Method: G.711 PCM 8kHz, Opus
 - 2) Audio Input/Output: Line Level I/O

- 3) External I/O Terminals: Alarm In/Alarm Out
 - j. Mechanical:
 - 1) Dimensions (with junction box): 296 mm x 126 mm x 106 mm (11.7" x 5.0" x 4.2")
 - 2) Weight:
 - a) Without junction box: 1.31 kg (2.88 lbs)
 - b) With junction box: 1.78 kg (3.92 lbs)
 - 3) Construction Material:
 - a) Dome Bubble: polycarbonate
 - b) Body: aluminum
 - c) Housing: aluminum
 - d) Finish: powder coat, Pantone 427C.
 - k. Electrical
 - 1) Power Source: PoE IEEE 802.3af Class 3 compliant, 12 VDC Aux
 - 2) IR Illuminator: turns off if temperature is 60°C (140°F) or higher.
 - 3) RTC Battery Backup: 3V manganese lithium.
 - 4) PoE: 13 W max
 - 5) Memory: 1 GB RAM, 512 MB flash
 - l. Environmental:
 - 1) Temperature:
 - a) Operating: -40°C - 60°C (-40°F - 140°F)
 - b) Storage: -10°C - 70°C (14°F - 158°F)
 - m. Humidity: 0 – 95% non-condensing
4. H5A DUAL HEAD CAMERA (Requires Cloud Connector)

(Type 5 on Drawings)

Model Number – 10.0C-H5DH-DO1-IR

- a. The Cloud-Hosted Dual Head Camera shall be the Avigilon Alta H5A Dual Head Camera. The camera shall be an indoor network dual head camera with 5 MP image resolution, equipped with Artificial Intelligence (AI) and audio analytics, and with the option for wide angle or telephoto lenses.
- b. Image Sensor:
 - 1) Size: 1/2.7" progressive scan CMOS
 - 2) Resolution: 5 MP
 - 3) Aspect Ratio:
 - a) 5 MP: 4:3
- c. Dynamic Range:
 - 1) 5 MP: HDR Off: 82 dB; HDR On: 120 dB
- d. Maximum Streaming Resolutions:
 - 1) 5 MP: 5184 x 1944 pixels
- e. Lens:
 - 1) 3.4 – 7.0 mm
 - a) Maximum IR illumination range: with high power 850 nm LEDs
 - (1) 5 MP:
 - (2) 30 m (98') full tele
 - (3) 15 m (49') full wide
 - b) Minimum illumination:
 - (1) 5 MP:
 - (2) With IR: 0 lux
 - (3) Without IR: 0.01 lux in color mode

- (4) 0.005 lux in monochrome mode
 - c) Horizontal Field of View:
 - (1) 5 MP: 43° - 91°
 - d) Vertical Field of View:
 - (1) 5 MP: 32° - 67°
- f. Video:
 - 1) Compression type: H.264, MJPEG
 - 2) Electronic Shutter Control: Automatic
 - 3) Day/Night Control: Automatic
 - 4) Flicker Control: 50-60 Hz
 - 5) Iris Control: N/A
 - 6) White Balance: Automatic
 - 7) Privacy Zones: up to 64 zones
- g. Network:
 - 1) Type: 100 BASE-TX
 - 2) Cabling Type: minimum Cat-5
 - 3) Connector: RJ-45
 - 4) ONVIF: Profile S, T, G, M compliant
 - 5) Protocols: IPv6, IPv4, HTTP, HTTPS, SOAP, DNS, NTP, RTSP, RTCP, RTP, TCP, UDP, IGMP, ICMP, DHCP, ARP, HSTS
 - 6) Streaming Protocols: WebRTC, RTP/RTSP/UDP, RTP/RTSP/TCP, RTP/RTSP/HTTP/TCP, RTP/RTSP/HTTPS/TCP
 - 7) VMS Platform Compatibility: Avigilon Alta Aware, Avigilon Unity/ACC, 3rd-party VMS (must run Unity firmware)
- h. Auxiliary I/O:
 - 1) Audio Compression Method: G.711 PCM 8kHz, Opus
 - 2) Audio Input/Output: Line Level I/O
 - 3) External I/O Terminals: Alarm In/Alarm Out
- i. Mechanical:
 - 1) Dimensions: D x H
 - a) Surface Mount: 218 mm x 118 mm (8.6" x 4.6")
 - b) In-Ceiling Mount: 237 mm x 137 mm (9.3" x 5.4")
 - c) Pendant Mount: 230 mm x 129 mm (6.1" x 4.6")
 - 2) Weight:
 - a) Surface Mount: 1.25 kg (2.75 lbs)
 - b) In-Ceiling Mount: 2.33 kg (5.13 lbs)
 - c) Pendant Mount: 1.67 kg (3.67 lbs)
 - 3) Construction Material:
 - a) Dual Head Dome Bubble, Body & Housing: Aluminum
 - 4) Finish: Cast, powder coated close to RAL9002
- j. Electrical
 - 1) Power Source: PoE IEEE 802.3af Class 3 compliant, 12 VDC Aux
 - 2) IR Illuminator:
 - a) Turns off if temperature is 60°C (140°F) or higher.
 - b) Will operate at 50% power if the temperature is between 40°C (104°F) and 52°C (117°F).
 - c) Hysteresis: 2°C (3.6°F).
 - 3) RTC Battery Backup: 3V manganese lithium.
 - 4) PoE: 10 W max (8 W with no IR or IR disabled).
 - 5) Memory: 1 GB RAM, 512 MB flash
- k. Environmental:
 - 1) Operating Temperature:

- a) Indoor Dome: -10°C - 60°C (-14°F - 140°F)
- b) Outdoor Dome: -40°C - 60°C (-40°F - 140°F)
- 2) Storage Temperature:
 - a) Indoor Dome: -10°C - 70°C (-14°F - 158°F)
 - b) Outdoor Dome: -10°C - 70°C (14°F - 158°F)
- 3) Humidity: 0 – 95% non-condensing
- I. Analytic Rules Supported:
 - 1) Objects in Area
 - 2) Object Loitering
 - 3) Objects Crossing Line
 - 4) Object Counting
 - 5) Object Line Crossing Counting

5. CLOUD-HOSTED MULTISENSOR CAMERA

Three Image Sensors – 15C-H5A-3MH-30 (Type 6 on Drawings)

Four Image Sensors – 20C-H5A-4MH-30 (Type 7 on Drawings)

- a. The Cloud-Hosted Multisensor Camera shall be the Avigilon Alta H5A Multisensor Camera. The camera shall be an indoor/outdoor multisensor IP camera with up to four sensors, equipped with Artificial Intelligence (AI) and audio analytics, and options for wide angle or telephoto lenses.
- b. Image Sensor:
 - 1) Size: 1/2.8" CMOS
 - 2) Active Pixels (H x V):
 - a) 5.0 MP: 2592 (H) x 1944 (V) 4:3
- c. 3 x Image Sensors Max Resolution:
 - 1) 5.0 MP: 7776 x 1944 (4:3)
- d. 4 x Image Sensors Max Resolution:
 - 1) 5.0 MP: 10368 x 1944 (4:3)
- e. IR Illumination - optional (high power 850 nm LEDs): 30 m (98') max distance at 0 lux when camera is mounted at 4 m (13') off the ground.
- f. Minimum Illumination:
 - 1) 5.0 MP:
 - 2) 0.020 lux (f/1.5) in color mode
 - 3) 0.018 lux (f/1.5) in monochrome mode
 - 4) 0 lux with optional IR illuminator
- g. Dynamic Range:
 - 1) HDR On: 120 dB, true HDR, dual exposure
 - 2) HDR Off: 80 dB
- h. 3D Noise Reduction Filter Supported
- i. Maximum Frame Rate (60 Hz / 50 Hz):
 - 1) 5.0 MP: 24 fps / 25 fps
- j. Image Control:
 - 1) Compression type: H.264, Motion JPEG
 - 2) Electronic Shutter Control: Automatic
 - 3) Day/Night Control: Automatic
 - 4) Flicker Control: 60 Hz / 50 Hz
 - 5) White Balance: Automatic
 - 6) Privacy Zones: up to 64 zones
- k. Lens (per image sensor):
 - 1) Focal Length: 3.3 - 5.7 mm

- 2) Field of view:
 - a) Horizontal:
 - (1) 5.0 MP: 53° - 99° (4:3)
 - b) Vertical:
 - (1) 5.0 MP: 39° - 69° (4:3)
- 3) Aperture Range: f/1.5 - f/1.9
- 4) Control: Fixed Iris, Remote Focus and Zoom
- l. Video:
 - 1) Compression type: H.264 and MJPEG
 - 2) Dynamic range:
 - a) HDR On: dual-exposure 120 dB true HDR
 - b) HDR Off: 80 dB
 - 3) The camera shall provide AI-based video analytics to include people and vehicle presence.
 - a) Small and medium vehicles (sedans, SUV, pickup truck).
 - b) Large vehicles (bus, truck).
 - c) Two-wheel vehicles (bicycle, motorcycle).
 - d) Unclassified vehicles.
 - e) Person
 - f) Color of clothing and vehicles.
 - g) Face (US only based on location).
- m. Network:
 - 1) Type: Gigabit ethernet, 100BASE-TX, 1000BASE-TX
 - 2) Cabling Type: minimum Cat-5E
 - 3) Connector: RJ-45
 - 4) ONVIF: Profile S, T, G and M compliant
 - 5) Protocols: IPv4, HTTP, HTTPS, SOAP, DNS, NTP, RTSP, RTCP, RTP, TCP, UDP, IGMPv3, ICMP, DHCP, HSTS
 - 6) Streaming Protocols: WebRTC, RTP/RTSP/UDP, RTP/RTSP/TCP, RTP/RTSP/HTTP/TCP, RTP/RTSP/HTTPS/TCP
 - 7) VMS Platform Compatibility: Avigilon Alta Aware, Avigilon Unity/ACC, 3rd-party VMS (must run Unity firmware)
- n. Auxiliary I/O:
 - 1) Audio Compression Method: G.711 PCM 8kHz, Opus
 - 2) Audio Input/Output: Line Level I/O
 - 3) External I/O Terminals: Alarm In/Alarm Out
- o. Electrical
 - 1) Power Consumption:
 - a) In-Ceiling:
 - (1) 26 W with 24 VDC
 - (2) 37 VA with 24 VAC
 - (3) 25.5 W with IEEE 802.3at Type 2 (PoE+)
 - b) Surface Mount:
 - (1) With IR:
 - 52 W with 24 VDC
 - 74 VA with 24 VAC
 - 51 W with high-power PoE (PoE++)
 - (2) Without IR:
 - 26 W with 24 VDC
 - 37 VA with 24 VAC
 - 25.5 W with IEEE 802.3at Type 2 (PoE+)
 - c) Pendant Mount:

- (1) With IR:
 - 52 W with 24 VDC
 - 74 VA with 24 VAC
 - 51 W with high-power PoE (PoE++)
- (2) Without IR:
 - 26 W with 24 VDC
 - 37 VA with 24 VAC
 - 25.5 W with IEEE 802.3at Type 2 (PoE+)
- 2) External Power: 24 VDC +/- 10%; 24 VAC rms +/- 10%, 50 or 60 Hz
- 3) PoE:
 - a) In-Ceiling Mount:
 - (1) 30 W IEEE 802.3at Type 2 (PoE+)
 - b) Surface Mount:
 - (1) With IR: 60 W (PoE++): IEEE 802.3bt Type 3, Cisco UPoE or legacy high-power PoE.
 - (2) Without IR or with Up to 35% IR power: 30 W IEEE 802.3at Type 2 (PoE+)
- 4) Redundant Power: Seamless failover between PoE and Aux and back without interruption in camera operation.
- p. Mechanical:
 - 1) Dimensions: D x H
 - a) Surface Mount: 304 mm x 114 mm (11.95" x 4.48")
 - (1) In-Ceiling Mount:
 - (2) Overall: 298 mm x 161 mm (11.75" x 6.33)
 - (3) Below Mounting Surface: 298 mm x 64 mm (11.75" x 2.52")
 - b) Pendant Mount:
 - (1) With Wall Arm: 385 mm x 262 mm x 299 mm (15.15" x 10.3" x 11.77")
 - (2) With NPT Adapter: 299 mm x 248 mm (11.77" x 9.76")
 - 2) Weight:
 - a) Surface Mount:
 - (1) Mount: 950 g (2.1 lbs)
 - (2) Bezel: 1250 g (2.8 lbs)
 - (3) Camera Module (4 lenses): 1590 g (3.5 lbs)
 - (4) Optional IR Illuminator Ring: 670 g (1.5 lbs)
 - b) In-Ceiling Mount:
 - (1) Mount: 1100 g (2.4 lbs)
 - (2) Bezel: 490 g (1.1 lbs)
 - (3) Camera Module (4 lenses): 1590 g (3.5 lbs)
 - c) Pendant Mount:
 - (1) With Wall Arm: 1190 g (2.6 lbs)
 - (2) With NPT Adapter: 470 g (1.04 lbs)
 - (3) Pendant: 1680 g (3.7 lbs)
 - (4) Bezel: 1250 g (2.8 lbs)
 - (5) Camera Module (4 lenses): 1590 g (3.5 lbs)
 - (6) Optional IR Illuminator Ring: 670 g (1.5 lbs)
 - 3) Body Construction Material:
 - a) In-Ceiling: Aluminum, plastic dome trim
 - b) Surface Mount: Aluminum
 - c) Pendant Mount: Aluminum
 - 4) Finish:
 - a) In-Ceiling Mount: plastic, injection molded, Pantone 427C.
 - b) Surface Mount: Cast, Anodized and Powder Coated, Pantone 427C.

- c) Pendant Mount: Cast, Anodized and Powder Coated, Pantone 427C.
- q. Environmental:
 - 1) Operating Temperature:
 - a) In-Ceiling Mount: -10°C - 50°C (14°F - 122°F)
 - b) Surface Mount: -40°C - 60°C (-40°F - 140°F)
 - c) Pendant Mount: -40°C - 60°C (-40°F - 140°F)
 - 2) Storage Temperature:
 - a) In-Ceiling Mount: -30°C - 70°C (-22°F - 158°F)
 - b) Surface Mount: -30°C - 70°C (-22°F - 158°F)
 - c) Pendant Mount: -30°C - 70°C (-22°F - 158°F)
 - 3) Humidity: 0 – 95% non-condensing
- r. IR Illuminator:
 - 1) In-Ceiling: N/A
 - 2) Surface Mount & Pendant Mount:
 - a) IR power will operate at 100% if the temperature is between -40°C - 44°C (-40°F - 111°F).
 - b) IR power will reduce to 60% if the temperature is between 44°C - 53°C (111°F - 127°F).
 - c) IR power will turn off if temperature is 53°C (127°F) or higher
 - d) Hysteresis: 6°C (10.8°F).
 - e) For 25.5 W PoE+, IR power will operate at only 35% and will turn off if the temperature is below -26°C (-15°F).
- s. Analytic Rules Supported:
 - 1) Objects in Area
 - 2) Object Loitering
 - 3) Objects Crossing Line
 - 4) Object Counting
 - 5) Object Line Crossing Counting
 - 6) License Plate Detection
 - 7) Audio
 - a) Glass Break
 - b) Loud Noise
 - c) Gun Shot
 - d) Screaming
 - e) Smoke Alarm
 - f) Car Alarm
 - g) Ultrasound Panic Alarm
 - h) Dog Barking
 - i) Tire Screeching

6. CLOUD-HOSTED PAN-TILT-ZOOM CAMERA

(Type 8 on Drawings)

In-Ceiling Model Number – 4.0C-H6A-PTZ-DC30-30

Pendant Model Number – 4.0C-H6A-PTZ-DP30-30

- a. The Cloud-Hosted Pan-Tilt-Zoom Camera shall be the Avigilon Alta H6A PTZ Camera. The camera shall be an indoor/outdoor IP pan-tilt-zoom camera with 360-degree views and up to 30X zoom. The PTZ camera shall be available in 2 MP or 4 MP image resolution, equipped with Artificial Intelligence (AI) and audio analytics, and options for wide angle or telephoto lenses.
- b. Image Sensor:
 - 1) Size: 1/1.8" progressive scan CMOS

- 2) Active Pixels (H x V):
 - a) 4 MP: 2560 (H) x 1140 (V)
- 3) Aspect Ratio: 16:9
- 4) Dynamic Range:
 - a) HDR On: up to 122 dB, dual exposure
 - b) HDR Off: 80 dB
- 5) Maximum Frame Rate:
 - a) 4 MP: (50 Hz/60 Hz) 25 fps/30 fps
- 6) Streaming Resolutions:
 - a) Maximum:
 - (1) 4 MP: 2560 x 1440
 - b) High:
 - (1) 4 MP: 1920 x 1080
 - c) Medium:
 - (1) 4 MP: 1280 x 720
 - d) Low:
 - (1) 4 MP: 640 x 360
- c. Image Control:
 - 1) Compression Type: H.264
 - 2) Electronic Shutter Control: Automatic
 - 3) Day/Night Control: Automatic, Manual
 - 4) Flicker Control: ON/OFF
 - 5) Iris Control: Automatic
 - 6) White Balance: Automatic
 - 7) Pan/Tilt Presets: 300 configurable
- d. Lens:
 - 1) Focal Length: 6.5 mm to 162.5 mm, f/1.6 – f/4.8
 - 2) Angle of View:
 - a) Wide (H x V): 58.1 x 34.8
 - b) Tele (H x V): 2.3 x 1.4
 - 3) Zoom: 30X Enhanced Optical
 - 4) Lens Control: Remote Zoom and Focus, Autofocus, Auto Iris
- e. Network:
 - 1) Type: 100BASE-TX, 1000BASE-T with Auto MDI/MDI-X speed
 - 2) Cabling Type: minimum Cat-5e
 - 3) Connector: RJ-45
 - 4) ONVIF: Profile S, T, G and M compliant
 - 5) Security: Password protection, HTTPS encryption
 - 6) Protocols: IPv6, IPv4, HTTP, HTTPS, SOAP, DNS, NTP, RTSP, RTCP, RTP, TCP, UDP, IGMP, ICMP, DHCP, ARP, HSTS
 - 7) Streaming Protocols: WebRTC, RTP/RTSP/UDP, RTP/RTSP/TCP, RTP/RTSP/HTTP/TCP, RTP/RTSP/HTTPS/TCP
 - 8) Secure Boot: Yes
 - 9) VMS Platform Compatibility: Avigilon Alta Aware, Avigilon Unity/ACC, 3rd-party VMS (must run Unity firmware)
- f. Auxiliary I/O:
 - 1) Audio Input/Output: Full Duplex Line Level input and output
 - 2) Audio Compression Method: G.711 PCM 8 kHz, Opus
 - 3) External I/O Terminals:
 - a) 3x Alarm In (3.5VDC/3.5mA MAX)
 - b) 1x NO Relay Out (32VDC/150mA MAX)
 - c) 1x Digital Out (13VDC/140mA MAX)

- d) 1x 12VDC source (11~13VDC/140mA MAX)
- g. Mechanical:
 - 1) Dimensions (L x W x H):
 - a) In-Ceiling Mount:
 - (1) Camera Only: 263 mm x 225 mm x 225 mm (10.4" x 8.8" x 8.8")
 - b) Pendant Mount:
 - (1) Camera Only: 302 mm x 242 mm x 242 mm (11.9" x 9.5" x 9.5")
 - 2) Weight:
 - a) In-Ceiling Mount:
 - (1) Camera Only: 3.45 kg (7.60 lbs)
 - b) Pendant Mount:
 - (1) Camera Only: 4.15 kg (9.13 lbs)
 - 3) Maximum Ceiling Thickness:
 - a) In-Ceiling Mount: 44.5 mm (1.75")
 - 4) Construction Material:
 - a) Dome Bubble: polycarbonate
 - b) Body: polycarbonate and aluminum
 - 5) Finish: Plastic injection mold close to RAL9002 and Black; Powdercoat Gray, AKZO Nobel JP301H; Sand Grain Texture with Satin Sheen
 - 6) Pan Range: 360° continuous
 - 7) Tilt Range: +/- 95° (190° total)
 - 8) Pan Speed:
 - a) 0.05-500°/sec w/IEEE 802.3at Type2, Class 4
 - b) 0.05-750°/sec w/IEEE 802.3bt Type 3, Class 6
 - c) 0.05-900°/sec w/IEEE 802.3bt Type 4, Class 8
 - 9) Tilt Speed:
 - a) 0.05-160°/sec w/ IEEE 802.3at Type 2, Class 4
 - b) 0.05-250°/sec w/ IEEE 802.3bt Type 3, Class 6
 - c) 0.05-300°/sec w/ IEEE 802.3bt Type 4, Class 8
 - 10) Preset Accuracy: 0.1°
- h. Electrical:
 - 1) Power Source:
 - a) In-Ceiling Mount: IEEE 802.3at Type 2, Class 4 compliant
 - b) Pendant Mount:
 - (1) IEEE 802.3at Type 2, Class 4 compliant
 - (2) IEEE 802.3bt Type 3, Class 6 compliant
 - (3) IEEE 802.3bt Type 4, Class 8 compliant
 - 2) PoE Power Consumption:
 - a) In-Ceiling Mount: 25W maximum
 - b) Pendant Mount: 70W maximum
 - 3) Power Source, Aux: Aux 24VDC/VAC +/- 10%
 - 4) AUX Power Consumption:
 - a) In-Ceiling Mount: 35W (DC source), 55VA (AC source) maximum
 - b) Pendant Mount: 70W (DC source), 85VA (AC source) maximum
 - 5) RTC Backup Battery: 3V manganese lithium
 - 6) Auxiliary Power Connector: 2-pin screw terminal removable plug
 - 7) Memory: 4GB RAM, 4GB Flash
- i. Environmental:
 - 1) Operating Temperature:
 - a) In-Ceiling Mount: -10°C to 50°C (14°F to 122°F)
 - b) Pendant Mount:
 - (1) -10°C to 60°C (14°F to 140°F), w/ IEEE 802.3at Type 2, Class 4

- (2) -40°C to 60°C (-40°F to 140°F), w/ IEEE 802.3bt Type 3, Class 6
- (3) -51°C to 60°C (-59.8°F to 140°F), w/ IEEE 802.3bt Type 4, Class 8
- 2) Boot Temperature:
 - a) In-Ceiling Mount: -10°C to 50°C (14°F to 122°F)
 - b) Pendant Mount:
 - (1) -10°C to 60°C (14°F to 140°F), w/ IEEE 802.3at Type 2, Class 4
 - (2) -25°C to 60°C (-13°F to 140°F), w/ IEEE 802.3bt Type 3, Class 6
 - (3) -40°C to 60°C (-40°F to 140°F), w/ IEEE 802.3bt Type 4, Class 8
- 3) Absolute Maximum Temperature: 74°C (165°F) per NEMA TS2 (Temp.)
- 4) Storage Temperature: -10°C to 70°C (14°F to 158°F)
- 5) Operating Humidity:
 - a) In-Ceiling Mount: 10 – 90% non-condensing
 - b) Pendant Mount: 10 – 100%
- j. Analytic Rules Supported:
 - 1) Appearance: Rule triggered when an object of the selected type and attributes appears.
 - 2) Loitering: Rule triggered when an object of the selected type and attributes loiters for the selected period of time.
 - 3) Counting: Rule triggered when the count of objects of the selected type either exceeds or is less than the selected threshold.
 - 4) Sound: Rule triggered when sounds of specified types is detected (requires compatible microphone and additional license for listening/recording of audio).
 - a) Supported Sound Events:
 - b) Glass Break
 - c) Loud Noise
 - d) Gun Shot
 - e) Screaming
 - f) Smoke Alarm
 - g) Car Alarm
 - h) Ultrasound Panic Alarm
 - i) Dog Barking
 - j) Tire Screeching
- k. Analytic Features:
 - 1) Object Detection: works with any view
 - 2) Appearance Search: works with any view
 - 3) Loitering Rules: any view
 - 4) Object Counting: any view
 - 5) Audio Analytics, Streaming and Recording: connect external microphone to audio line in
 - 6) Line Crossing: home position only
 - 7) Image Health: home position only
 - 8) License Plate Recognition: not currently supported
 - 9) Area of Interest: not currently supported
 - 10) Auto Tracking: not currently supported
 - 11) Privacy masks: not currently supported
 - 12) Anomaly Detection: not applicable

7. AVIGILON ALTA CLOUD CONNECTOR

a. **A2000 – P/N: APP-2000-80-BT**

- 1) A2000 is a 2U rack-mounted unit with 12 hard disks
- 2) Up to 100 cameras supported
- 3) Nvidia Quadro RTX GPU

- 4) SATA storage up to 192TB (raw), 160TB (net)
- 5) Flexible network options
- 6) 5-year warranty

PART 3 - EXECUTION

3.1 EXECUTION - GENERAL REQUIREMENTS

- A. Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the laws, ordinances, and rules, the matter shall be referred to the Architect / Design Consultant for direction before proceeding with that part of the work.
- B. Contractor shall meet the specifications and standards from the latest NFPA and NEC publications. In the event of any conflicts between Standards and Codes the more stringent shall take precedence.
- C. The Contractor shall install the materials in accordance with these specifications and the manufacturer's installation guidelines. Equipment and materials installed by the Contractor shall be free of defects and damage.
- D. No deviations from the plans, details or specifications shall be made without full consent in writing of the Architect / Design Consultant. The Contractor shall have written approval from the Architect / Design Consultant for any additional work beyond the Contract Documents prior to beginning such work.
- E. Prior to execution, Contractor shall verify no changes in software, licensing or hardware versions have occurred since the bidding of the project. In the event of any changes, Contractor shall verify system compatibilities with their proposed design and notify via RFI the Architect / Design Consultant / Owner if the newest version(s) will require any upgrades / additional costs to the existing system(s).
- F. In the event site conditions do not allow the contractor to follow the execution requirements specified herein or in the provided details, the Contractor shall submit via RFI an alternative means and methods that is approved in writing by the Architect / Design Consultant / Owner.
- G. The Contractor shall obtain written permission from the Architect / Design Consultant / Owner before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to: girders, beams, floors, walls, roofs, and/or ceilings.
- H. If the Contractor does not obtain written approval from the Architect / Design Consultant / Owner prior to proceeding with the work, the contractor shall not be reimbursed for the work.
- I. Contractor shall notify the Architect / Design Consultant / Owner a minimum of (1) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect / Design Consultant / Owner to perform a walkthrough, review the scope of work, schedule, and escalation procedures.
- J. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap cable, etc., and dispose of such items on a daily basis and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.
- K. The contractor shall be responsible for the repair of any damage caused by the contractor during the installation.
- L. The contractor shall test all cables prior to and post installation. By failing to perform this testing operation, the Contractor shall accept the cable as compliant and assume all liability for the replacement of the cable at no cost to the Owner should it be found defective at a later date.
- M. Contractor shall maintain a set of working specifications, design drawings, schedules, and record drawings to be always kept on site and shall update the record drawings with any changes on a weekly basis. Record drawings shall be made available for inspection at the request of the Architect / Design Consultant / Owner.
- N. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard

- product with the same manufacturer and model number.
- O. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Contractor's expense.
 - P. The contractor shall make all stored equipment and materials available for inspection at the request of the Architect / Design Consultant / Owner.
 - Q. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.
 - R. All devices shall be installed flush, plumb, and (where required) centered on the wall, ceiling tile or structure for which it is being installed, unless otherwise noted.
 - S. Devices installed in public spaces shall be mounted and secured using tamper- proof security fasteners unless otherwise noted.
 - T. Cables shall be properly supported in accordance with industry standards at all times. Improperly supported cables shall be corrected by the Contractor at no cost to the Owner.
 - U. Contractor shall be responsible to properly protect information outlets from damage by other trades during construction.
 - V. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.
 - W. The Contractor shall not install cables in conduits or sleeves without nylon bushings. Cables installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.
 - X. The manufacturer and contractor shall take positive measures to prevent the introduction of cybersecurity threats to the Owners technology infrastructure. These measures shall include but are not limited to:
 - 1. The contractor shall scan contractor owned equipment for cyber threats such as viruses, malware, ransomware, etc., prior to connecting the contractor owned devices to the Owners network.
 - 2. Ensure all technicians installing or configuring equipment are trained on the prevention of introduction of cyber threats to electronics, i.e., servers, and other associated equipment.
 - 3. All project documents shall be properly securely stored behind encryption and password protection to avoid unauthorized distribution of documents.
 - Y. All security system cabling shall be yellow in color.
 - Z. All security system cabling shall be plenum rated.
 - 1. All security system cabling shall be installed following the same pathway and support requirements as Division 27 Communications.

3.2 COORDINATION REQUIREMENTS

- A. The Contractor is responsible for the coordination of the following items and their respective disciplines included but not limited to.
- B. Coordinate with the Architect to ensure that:
 - 1. Adequate conduit is provided and that equipment backboxes are adequate for system installation.
 - 2. Adequate communication infrastructure and power has been provided and properly located for the security system equipment.
 - 3. Finishes and colors of all equipment visibly installed in public areas. Submit all finish and graphics for all equipment to the Architect for approval prior to installation.
 - 4. Camera views are not obstructed by landscaping, awnings, or any other obstacles.
 - 5. Mounting techniques are in compliance with construction techniques.
 - 6. Camera location and field of views are adequate and meets Owner's expectations.
- C. Coordinate with the Division 26 contractor for the following:
 - 1. Power requirements, conduit sizes/pathways, sleeves, back boxes, grounding, and bonding requirements of security devices in the following locations:
 - a. Interior of the building

- b. Exterior of the building
 - c. Pole, pedestals, canopies, awnings, building architectural surface, etc.
 - d. Special conditions (clean room, hazardous areas, roof top mounted devices, etc.).
 - e. License Plate Recognition (LPR) exact camera placement requirements.
- 2. Coordinate location and termination of earth ground for all device specified herein as required per manufacturer installation requirements.
- D. Coordinate with the Division 27 contractor for the following:
 - 1. Installation and power requirements of network infrastructure associated to the specified system.
 - 2. Associated patch cable lengths and quantities required for the specified system.
 - 3. Location, power, and backup requirements for rack mount equipment.
 - 4. Mounting and installation of injectors, midspans, extenders, surge protectors, etc.
- E. The Contractor is responsible for coordinating all VMS programming requirements with the Owner / Architect / Design Consultant.
- F. The Contractor shall coordinate with the Owner prior to installation for the following:
 - 1. Network IP addressing for networked system equipment, servers, and devices.
 - 2. Device labeling scheme
 - 3. Firmware/software updates
 - 4. Client workstations requirements and locations
 - 5. Location of rack mount equipment.
 - 6. Locations, type, programming, configuration, and Owner's final expectations for any Contractor Furnished Contractor Installed (CFCI) equipment and devices.
 - 7. Uninterruptible Power Supply (UPS) requirements.
 - 8. Painting of exposed, publicly visible conduit pathways
 - 9. Camera Views (Owner's Written Acceptance Required)

3.3 SYSTEM REQUIREMENTS

- A. General
 - 1. The Video Surveillance System (VSS) shall consist of server(s), software, licensing, workstations, cameras, power source, grounding/bonding, Video Surveillance cabling, and all other peripheral components as indicated on the drawing and specified herein.
 - 2. Any devices associated with the installation shall have the latest firmware updates/downloads via Owner approved secure link from the system software and/or remotely from the manufacturer.
 - 3. All Video Surveillance software, equipment and system requirements shall be installed per their respective Manufacturer Installation Guidelines.
- B. VMS System Programming
 - 1. **All** programming and configuration of the Video Surveillance Systems shall be accomplished by the Security Contractor.
 - a. The Security Contractor is responsible for all Video Surveillance System (VSS) programming to ensure the installed field devices, cameras, servers, workstations, media converters, etc., are communicating to the head-end equipment.
 - 2. System Configuration:
 - a. Camera recording and display configurations shall be arranged during the provisioning phase, based on coordination with Owner and the specifications.
 - b. Contractor shall coordinate with Owner to determine the required pre-programmed surveillance and event-initiated configurations.
 - 3. Graphical User Interface (GUI) Environment

- a. General
 - 1) Security Contractor shall create and provide maps for each site and building, and for each floor of the building where VSS devices are provided.
 - 2) The VSS client shall display color graphic maps, menus and real-time information regarding system configuration, camera location and status, in graphical format, as required by Owner and described herein. Contractor shall research icon usage and use same icons through the system.
 - a) Map Database: Contractor shall research (with Owner), design, develop and provide site and building maps described herein in complete operating condition including graphic representations, icons, alarm and control interfaces.
 - b) Individual Site Plans: Individual site plan maps shall include the entire site perimeter showing buildings, vehicle and foot traffic features and street frontage. Individual site plans may contain multiple buildings. Large-scale maps shall have dynamic zoom or designated "hot spot" areas to allow the capability to zoom into an area down to 1/8" scale. Site plans shall have icons for exterior mounted devices and entry/exit portals.
 - c) Building Maps: Building Maps shall include the building footprint and surrounding areas, ground floor plan, a floor stacking plan (elevation) and stairwell risers. Building plans shall have icons for exterior mounted devices and entry/exit portals.
 - d) Floor Plan Maps: Floor plan maps shall include rooms, corridors, elevators, door and room designations (number and usage), penetrable wall points, column supports, location of access control equipment and any other details necessary to clearly and completely depict the secured environment.
 - 3) Device Icons:
 - a) Individual site plans, building plans, and floor plan maps shall show text and icons for devices monitored and/or controlled by the DVMS.
 - b) The maps shall include active icons for video cameras allowing distinction between types, whose individual selection shall be supported via the GUI using the integration schemes described in the specifications.
- C. VSS Connectivity
 - 1. Owner Provided Network: Owner shall provide the network infrastructure for security systems, including backbone cabling, routers, network switches, and miscellaneous devices necessary to support and protect the security systems.
 - 2. The Contractor shall coordinate with the IT department and provide IT with detailed network requirements including but not limited to
 - a. Location and quantity of ports needed by network appliances
 - b. Bandwidth and throughput requirements at key locations
 - c. Coordinate IP and MAC addresses required by network appliances
 - d. Other information as necessary to establish communications and security protection for security systems and devices
 - 3. VSS Network: Base Servers, Network Video Recorders, and Client Workstations shall reside on Owners' Local Area (LAN) and/or Wide Area Network (WAN) to allow global activity and shared data interchange.
 - 4. Coordinate with the District's IT department to determine adequate network "firewalls" to maintain the security of VSS controls and information while connected to shared computer networks and transmission media.
 - 5. Surveillance Cameras
 - a. The Contractor shall have all on-site equipment, and personnel necessary to install, program, and troubleshoot devices during and after installation.
 - b. Unless otherwise stated, all cameras shall receive power through Power over

- Ethernet. The contractor is responsible for ensuring the power output of the network switch will meet the power requirements of the cameras to be installed. Any additional power will be the responsibility of the contractor to provide.
- c. The Contractor shall energize and commission equipment in accordance with manufacturer's instructions and guidelines. All installed cameras, mounts, accessories, and fasteners shall be properly rated for the environmental conditions in which they will be installed. The contractor is responsible for sealing and making watertight all exterior penetrations and equipment.
 - d. The Contractor is responsible for all the configuration of camera settings, IP address settings, recording settings, presets, naming conventions, etc. unless otherwise noted.
 - e. Default admin account usernames and passwords shall be reconfigured prior to connecting to the Owner's network. New admin accounts and passwords shall be Owner Provided. Account passwords and settings shall be held in confidence by the Contractor and secured throughout the duration of the project to prevent unauthorized access.
 - f. As part of initial installation, Contractor is responsible for focusing and aiming the camera in the direction as indicated in the drawings. Unless otherwise stated, camera lenses shall provide the maximum field of view coverage to the area to provide a usable, level, clear image, pending Owner's final approval. Contractor shall plan for a minimum of one additional trip to make final adjustments of camera field of views.
6. Surge Protection / Lightning Arrestors
- a. Protect all exterior or interior devices, control, power, signal cables and conductors that are power surges. Each surge protector shall be UL Listed.
 - b. Unless otherwise noted, surge protection devices shall be installed at both the edge and head end of the cabling run.
 - c. Surge devices shall be installed as close as possible to the equipment they are protecting.
 - d. Surge Protection shall be properly installed in an accessible ceiling or enclosure space to allow for cable removal during troubleshooting.
 - e. Include surge protection device locations on as-builts and shop drawings.
 - f. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.
 - g. Proper ground surge protection devices per the manufacturer installation requirements.
- D. Video Surveillance Cabling
- 1. Unless otherwise noted, all data cabling from end to end to support the Video Surveillance System and all related IP devices shall be provided, installed, and maintained by Div. 27 10 00/ the Owner.
 - a. Alternative communications means and methods shall be provided by Division 27/28 where applicable, including but not limited to:
 - 1) PoE over Fiber
- E. Device Labeling
- 1. Unless otherwise, all installed devices shall be labeled. Contractor shall verify device numbering scheme and Owner's current naming convention standard in writing in advance via RFI prior to generating any labels.
 - 2. Unless otherwise stated, all labels shall be machine printed and adhered to the device in a location that is visible and legible to the naked eye.
 - 3. All labeling in the field shall match the same labeling scheme in the closeout documents.
 - 4. Refer to Div. 27 specifications for data network device cabling requirements.
- F. Grounding and Bonding
- 1. All grounding and bonding shall be performed by a licensed electrical contractor to ensure the electrical integrity of the low voltage system and devices specified herein per federal / state / local codes and standards.

2. Contractor shall notify the Architect / Owner / Design Consultant via written RFI of any site conditions or installations that will require additional coordination.
 3. The contractor shall ensure proper grounding of shielded or non-shielded cabling and devices conform to the specified devices manufacturer's installation guidelines.
 4. Division 28 Contractor is responsible for coordinating with the Division 26 Contractor for grounding and bonding security devices per applicable codes and standards.
- G. Conduit, Boxes and Raceways (For Reference Only - By Division 26)
1. Install all conduit necessary for a complete installation but not limited to: in finished areas, in concealed areas, in chases, in furring's, in concrete slabs and/or above suspended ceilings. No exposed conduit shall be installed within public areas.
 2. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and as required by the NEC to provide a neat, industry-standard installation. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets, or heavy iron tie, tied to the black iron structural members supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.
 3. All conduits shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.
 4. All required inserts shall be drilled-in and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.
 5. Swab out and remove all burrs from conduit before any wires are pulled.
 6. Lay out and install conduit runs to avoid proximity to hot pipes. In no case shall a conduit be run within 75 mm of such pipes, except where crossings are unavoidable and then the conduit shall be kept at least 25 mm from the covering of the pipe crossed.
 7. Provide fire stops where conduits penetrate fire rated walls and/or floors.
 8. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the Architect.

3.4 TESTING REQUIREMENTS

- A. The Contractor shall perform a burn-in of the system that is in accordance with the manufacturer's installation guidelines.
1. All devices shall be powered up and tested in a phased approach in a controlled testing environment on or off premise (to be coordinated with the Owner).
 2. Update firmware with most up to date version (to be coordinated with the Owner).
- B. Contractor shall conduct a five (5) day burn in test. Each system hardware device shall remain operational during the burn-in test for a minimum of eight (8) hours without failure.
1. Contractor shall provide successful burn-in results in writing to the Architect / Design Consultant prior to final acceptance.
- C. Security Contractor shall conduct a complete QA/QC test of the entire system and provide a written report of the test results (Punchlist). The tests shall include, but not limited to:
1. Hardware
 2. Software
 3. Network Connectivity
 4. Device Power
 5. Configure system device settings
 6. Setting camera views (aim & focus)
 7. Archiving of video footage
- D. It is the responsibility of the Contractor to verify that all devices, equipment, software, interfaces, sub-system interfaces and integrations are fully functional and operational.
- E. The contractor shall rectify all issues discovered during the QA/QC process and shall document these corrections via a Contractor provided punch-list.
1. At a minimum, the punch-list shall contain:
 - a. Date of the item identified

- b. Description of the discrepancy with photographs, as necessary.
 - c. Date the item was rectified
- F. All QA/QC items shall be corrected, and an electronic report surrendered to the Architect / Design Consultant prior to calling for Substantial Completion.

3.5 TRAINING REQUIREMENTS

- A. Training outline with Owner sign off specific to the vertical market served.
- B. Provide (4) hours of training for two (2) persons on each system.
- C. The Contractor shall closely coordinate with the Owner to establish a training syllabus and schedule. Submit a comprehensive training curriculum to the Owner once all preliminary coordination is complete. The Owner will revise and comment on the curriculum as required.
- D. Contractor training shall be conducted onsite/virtually. Training shall be conducted by a Factory Certified trainer from the Manufacturer.
- E. Operator training shall be structured to provide the appropriate users the information required for them to be able to perform the following tasks:
 - 1. All operating procedures
 - 2. System configuration
 - 3. Camera Configuration
 - 4. Rules Configuration
 - 5. Alarm acknowledgement, alarm response logging, and map graphics functionality
 - 6. Manipulation of cameras and presets.
 - 7. Archiving Recorded Video
- F. Administrative training shall include, but not be limited to the following:
 - 1. All operating system procedures, configuration variables and graphic user interface (GUI)
 - 2. Report generation
- G. Record, label, and catalog all training on DVD and "user's manual" written specifically for the Owner personnel onsite, for daily routine operations of the systems. Provide the DVD and user's manual to the Owner for future in-house training sessions and / or reviews. Furnish all temporary equipment necessary for recording all training sessions. Maintain accurate and up-to-date time sheets of all training sessions.
- H. The Owner reserves the right to use any excess training hours, not used by the time of system completion, for future training as requested until the total number of training hours has been completed.

3.6 FIELD OBSERVATIONS

- A. A minimum of ten business days in advance, Contractor shall notify the Design Consultant and Owner as to the readiness for a Field Observation for the following at a minimum but not limited to:
 - 1. Rough-In Observation – after conduits have been installed, but before walls have been installed.
 - 2. Above Ceiling Observation – after cabling has been installed, but before ceilings have been installed.
 - 3. Final Site Observation – a minimum of two weeks before Substantial Completion.
- B. During Design Consultant's Final Site Observation of the installed systems, provide a minimum of one factory-trained/certified technician on the operation of all installed systems for up to (1) 8-hour day to assist with Design Consultant's functional testing.
- C. Non-Conforming Work (Punch-List)
 - 1. After receipt of written notice of deficiencies (Punch-List), Contractor shall correct all defective work within ten business days. If the work has been identified to be corrected by the Architect/Design Consultant, the Contractor shall remediate it in conformance with the contract documents at no cost to the Owner.

3.7 SUBSTANTIAL COMPLETION

- A. It is the responsibility of the Contractor to ensure that all punch list items are 100% complete. The Contractor shall complete an internal Quality Assurance / Quality Control inspection, make all corrections, document the deficiencies and corrections prior to requesting for any further inspections with the Architect / Owner / Design Consultant.
- B. Prior to any Substantial Completion, the Contractor shall submit a minimum two sets of preliminary (first draft) Record Drawings (As-Built) to the Architect/Design Consultant. The preliminary Record Drawings are to be used by the Architect/Design Consultant to conduct the system substantial completion inspection.
- C. The Contractor shall notify the General Contractor / Architect / Design Consultant that all the items noted above have been completed and the installation is ready for inspection.
- D. The Architect / Design Consultant shall schedule an inspection of the installation with the General Contractor and the Installing Contractor(s) present.
- E. The Substantial Completion Inspection shall consist of the following:
 - 1. The Project Manager/Superintendent and Installation Technician shall be on site with all tools, materials, and equipment ready to resolve any minor issues identified.
 - 2. The Design Consultant or designated representative shall visually inspect the installation in accordance with the official design documents.
 - a. The Contractor shall be prepared to remove and reinstall (minimum 10%) randomly selected security devices to inspect the mounting, cabling, terminations, connectors, labeling, tampers.
 - 3. Punch list items shall be identified and documented in a provided punch list with a date and description of the issue found, and a date the discrepancy was addressed and the resolution.
- F. Provide all personnel, equipment, and supplies necessary to perform all site testing. All video surveillance cameras shall be pointed and aimed in the views as shown in the drawings and using best practices. Contractor shall provide a minimum two employees to verify all cameras have been pointed and aimed to achieve Owner final approval. A manufacturer's representative may be present on site to answer any questions that may be beyond the technical capability of the Contractor's employees, if the Contractor so elects or by specific request of the Architect or Owner, at no charge to the Architect or Owner.
- G. The Contractor shall coordinate with the Architect/Design Consultant on security related construction clean-up and patch work requirements. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, remove all waste materials, rubbish, the Contractor's and its subcontractors' tools, construction equipment, machinery, and all surplus materials.
- H. At their discretion, if the Design Consultant or their designated representative deems the site not ready for inspection/observation, the inspection will be cancelled. The Contractor(s) shall immediately address all issues identified, and shall reschedule the inspection in a timely manner so as not to affect the overall construction schedule.
- I. Adjustments and Documentation: energizing and testing the systems, make adjustments and document the setting of controls, configurations, as applicable. Tabulate all data along with an inventory of test equipment, a description of testing conditions and a list of test personnel.
- J. Test Documentation: Create and provide complete test reports documenting the results of the each performed on each device, control panel, power supply, and other elements of the system. Copies of preliminary test data shall accompany copies of performance testing data as part of the Operating and Maintenance submittal.

3.8 PROJECT CLOSEOUT DOCUMENTATION

- A. As-Built Drawings
 - 1. Drawings shall be provided to the Architect / Owner / Design Consultant at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Architect / Owner / Design Consultant.
 - 2. Unless otherwise requested, Contractor shall provide digital copies of close-out documents and deliver to the Architect / Owner / Design Consultant electronically.

3. As-Built drawings shall be produced in AutoCAD/Revit in the most current or compatible version and provided electronically in .dwg and/or .pdf format.
 4. Drawings shall be provided in the original size as issued by the Architect/Design Consultant.
 5. Drawings shall retain the formatting and title block of the original drawings as issued by the Architect/Design Consultant.
 6. Provide a conformed set of Drawings as related to the project, depicting the condition of the Video Surveillance system as installed to include but not limited to:
 - a. ASI, PR, and Addendum items installed throughout the duration of the project.
 7. Provide a hard copy of the conformed set of drawings to be physically stored at the end of the project in a designated Video Surveillance System enclosure. Coordinate with Owner for final storage location.
 8. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of the following not limited to:
 - a. Video Surveillance System Riser / Signal Flow Diagrams
 - b. Video Surveillance System Backboard Layouts
 - 1) To include Video Surveillance boards, power supplies, pathways, etc.
 - c. Sleeves, Backbone Cabling and Communication pathways
 - d. Video Surveillance System device locations and labeling scheme.
 9. **As-builts shall include each MAC Address clearly labeled next to each IP device it is associated with, IE. each camera and intelligent controller.**
- B. Operation & Maintenance Manuals
1. Unless otherwise noted, provide O&M manuals electronically to Owner to include all drawings, product datasheets, hardware manuals as related to the project.
 2. Coordinate with the Owner for provisioning of physical storage devices (Hardcopy, Flash Drive, CD/DVDs)
- C. Manufacturer's Product Warranty
1. Certificate of product warranty shall be provided to the Architect / Owner / Design Consultant at the time of final system acceptance. Final payment will not be recommended until this certificate of product warranty is received and approved by the Architect/Design Consultant.
 2. The manufacturer of the solution shall furnish a product warranty as per the specifications starting at final system acceptance.
 3. One original and two copies of the Manufacturer's product warranty shall be provided.
- D. Contactor's Statement of Warranty
1. Statement of warranty shall be provided to the Architect/Design Consultant at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect/Design Consultant.
 2. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.
 3. One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e., Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

END OF SECTION 28 23 00

SECTION 28 31 00 – FIRE DETECTION AND NOTIFICATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- A. 26 05 00 – Grounding and Bonding
- B. 26 05 29 – Electrical Hangers and Supports
- C. 26 05 33 – Raceway and Boxes

1.3 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, connection and testing of microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated networked system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Voice Evacuation Fire Alarm Control Panel (FACP), Voice Evacuation devices, auxiliary control devices, annunciators, Ethernet and/or digital alarm communications to central stations and wiring as shown on the drawings, specified herein, and per the manufacturer's requirements.
- B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for Local Protected Premises Signaling Systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.
 - 1. The Secondary Power Source of the fire alarm control panel will be capable of providing at least 24 hours of backup power with the ability to sustain 5 minutes in alarm at the end of the backup period
- C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
- D. The FACP and peripheral devices shall be manufactured or supplied 100% by a single U.S. manufacturer (or division thereof).
- E. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.
- F. The FACP shall meet requirements of UL ANSI 864 Ninth Edition

1.4 SCOPE

- A. An intelligent, microprocessor-controlled, fire alarm detection system shall be designed, furnished, and installed in accordance to the project specifications and drawings.
- B. Contractor shall provide a new FACP **with voice evacuation**. Provide voice evacuation speakers in locations in order to provide code required dB levels during an alarm event.
- C. All devices shall be fully addressable utilizing all final room graphic names and numbers.
- D. Any devices installed in high ceiling areas shall have programming reference on device that can be read from floor level.
- E. Contractor shall connect all back-up batteries per manufacturer's instructions.

F. Basic Performance:

1. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B) as part of an addressable device connected by the SLC Circuit.
2. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y) as part of an addressable device connected by the SLC Circuit. Cable shall be Belden 6341PC 18 AWG 2 Pair, CMP Plenum Cable, Individually Shielded or equivalent.
3. All circuits shall be power-limited, per UL864 requirements.
4. A single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
5. Alarm signals arriving at the main FACP shall not be lost following a primary power failure or outage of any kind until the alarm signal is processed and recorded.

G. Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system's initiating devices, the following functions shall immediately occur:

1. The system Alarm LED on the FACP shall flash.
2. A local sounder with the control panel shall sound.
3. A backlit 80-character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
4. In response to a fire alarm condition, the system will process all control programming and activate all system outputs (alarm notification appliances and/or relays) associated with the point(s) in alarm. Additionally, the system shall send events to a central alarm supervising station via either dial-up over PSTN or Internet or Intranet via PSDN or virtual private network.
5. If there are any discrepancies between the drawings and specification or among themselves, the contractor shall request clarification prior to providing pricing for the scope of work. If a request is not issued and a response not provided via a posted addendum, the contractor shall provide pricing for the most costly scenario and obtain clarification during the course of the project.

1.5 GENERAL REQUIREMENTS

- A. All fire alarm system designs shall meet local, state and municipal codes.
- B. Main fire alarm control panel to be located in building technology headend room (MDF). Do not install in mechanical or electrical rooms.
- C. Local annunciator panel with microphone to be located in front administration area.
- D. Do not install panel battery cabinet above ceiling. Shall be installed at standard height for servicing without ladder.
- E. Review location of all fire alarm pull stations with owner prior to final design submission to AHJ.

- F. Provide all cabling and devices to integrate with the First Responder Antenna System (FRAS / ERRC-BDA) on all projects.
- G. Provide switch bank allowing end user to enable and disable service groups.
- H. Fire alarm system shall be able to be tested during school hours. Coordinate with CISD Maintenance and Police Department for any system tests.
- I. Fire alarm contractor responsible for adding points for FRAS / ERRC-BDA system.
- J. Provide protective covers on all fire alarm devices installed in gyms.
- K. System shall conform to NFPA 72 and NFPA 101

1.6 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
 - 1. National electric Code Article 760
 - 2. UL1971 Visual Signaling Appliances
 - 3. ANSI 117.1 Visual Devices
- B. National Fire Protection Association Standards:
 - No. 13 Sprinkler Systems
 - No. 70 National Electric Code (NEC)
 - No. 72 National Fire Alarm Code
 - No. 101 Life Safety Code
 - No. 38 Manually Actuated Signaling Boxes
 - No. 217 Smoke Detectors, Single and Multiple Stations
 - No. 228 Door Closers—Holders for Fire Protective Signaling Systems
 - No. 268 Smoke Detectors for Fire Protective Signaling Systems
 - No. 268A Smoke Detectors for Duct Applications
 - No. 346 Waterflow Indicators for Fire Protective Signaling Systems
 - No. 464 Audible Signaling Appliances
 - No. 521 Heat Detectors for Fire Protective Signaling Systems
 - No. 864 Control Units for Fire Protective Signaling Systems
 - No. 1481 Power Supplies for Fire Protective Signaling Systems
 - No. 1610 Central Station Burglar Alarm Units
 - No. 1638 Visual Signaling Appliances
 - No. 1971 Visual Signaling Appliances
 - No. 2017 General-Purpose Signaling Devices and Systems
- C. Local & State Building Codes
- D. Requirements of Local Authorities having Jurisdiction
- E. Underwriters Laboratories Inc. (UL) - USA:
 - No. 38 Manually Actuated Signaling Boxes
 - No. 50 Cabinets and Boxes
 - No. 864 Control Units for Fire Protective Signaling Systems
 - No. 268 Smoke Detectors for Fire Protective Signaling Systems
 - No. 268A Smoke Detectors for Duct Applications
 - No. 346 Waterflow Indicators for Fire Protective Signaling Systems
 - No. 464 Audible Signaling Appliances
 - No. 521 Heat Detectors for Fire Protective Signaling Systems

No. 1971 Visual Notification Appliances

CAN/ULC S524-01 Standard for Installation of Fire Alarm Systems

1. The FACP shall be ANSI 864, 9th Edition Listed. Systems listed to ANSI 864, 8th edition (or previous revisions) shall not be accepted.
- F. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
- G. All requirements of the Authority Having Jurisdiction (AHJ).
- H. American's with Disabilities Act (ADA)

1.7 SYSTEM DESCRIPTION

- A. Multiprocessor-Based:
 1. The system shall be of multiprocessor design to allow maximum flexibility of capabilities and operation.
- B. Field Programmable:
 1. The system shall be capable of being front-panel programmed or by Field Configuration Program (FCP) allowing programming to be downloaded via computer from any node on the network.
- C. RS-232C Serial Output:
 1. A supervised RS-232C serial port shall be provided to operate remote printers and/or video terminals, accept downloaded program from the computer, or provide an 80-column readout of alarms, troubles, location descriptions, time, and date.
 2. Communication shall be via standard ASCII code operating at a 9600-baud rate.
- D. Control-by-Event (CBE) Program:
 1. Operation of a manual station or automatic activation of any smoke sensor, heat sensor, or waterflow device shall activate system control-by-event program to cause:
 - a. All notification appliances to sound in continuous pattern and strobes to flash.
 - b. Shut down all air-handling units as specified herein.
 - c. "SYSTEM ALARM" LED shall flash and panel sounder shall pulse.
 - d. Indicate on the 80-character alphanumeric panel display a description of the specific analog/addressable device in alarm. The display shall be of the liquid crystal type (LCD), clearly visible in the dark or in poor light conditions.
 - e. Close all magnetically held doors automatically.
 - f. Energize programmed solenoids for activating sprinkler or extinguishing systems.
 - g. Perform additional function as specified herein or as indicated on the Drawings.
 - h. Notify the Fire Department.
- E. General System Operation:
 1. When an alarm occurs, the control panel as well as any other control panel in the

same region, or any control panel programmed as a global annunciator shall indicate an alarm condition until manually reset.

2. The alarm may be acknowledged by pressing the "ALARM ACKNOWLEDGE" switch.
3. This shall silence the panel sounder and change the "ALARM" LED from flashing to steadily lit.
4. All notification appliances may be silenced by operating the "SIGNAL SILENCE" switch on any panel in the same region or from any panel programmed as a global annunciator.
5. This shall steadily light the "SYSTEM SILENCED" LED.
6. If a subsequent alarm is activated, notification appliances shall "resound" until again silenced.
7. Once silenced, all notification appliances may be restored by operating the "SIGNAL SILENCE" switch.
8. Waterflow zones shall be non-silenceable.

F. Alarm Verification:

1. Smoke sensor alarm verification shall be a standard option, while allowing any dry contact device, such as manual stations and heat detectors, to create an immediate alarm.
2. This feature shall allow smoke sensors that are installed in environments prone to nuisance or unwanted alarms to operate according to following sequence:
 - a. Smoke Sensor Alarm: At time = 0.
 - b. Pre-alarm Window: 15 seconds. A distinctive pre-alarm indication shall be displayed.
 - c. Reset: 5 seconds. Occurs at end of pre-alarm window.
 - d. Alarm Verification Window: 90 seconds. The system shall respond to a second alarm from the same smoke sensor as the system alarm.
 - e. System Ready: No alarm verification.
 - f. The verification sequence is suspended once the system alarm is activated.

G. Alarm Signals:

1. All alarm signals shall be automatically latched or "locked in" at the control panel until the operated device is returned to normal and the control panel is manually reset.
2. When used for waterflow, the "SIGNAL SILENCE" switch shall be bypassed.

H. Electrically Supervised:

1. Each signaling line circuit and notification appliance circuit shall be electrically supervised for opens, shorts, and ground faults.
2. Occurrence of a fault shall activate system trouble circuitry, but shall not interfere with proper operation of a circuit that does not have a fault condition.
3. The yellow "SYSTEM TROUBLE" LED shall light and the system audible sounder shall steadily sound when trouble is detected in the system. Failure of power, opens, or short circuits on notification appliance or signaling line circuits, disarrangement in system wiring, failure of microprocessor or identification module, or system ground faults shall activate this trouble circuit.

4. The trouble signal may be acknowledged by operating the "ALARM ACKNOWLEDGE" switch. This shall silence the sounder. If subsequent trouble conditions occur, trouble circuitry shall resound.
 5. During alarm, all trouble signals shall be suppressed with exception of lighting the yellow "SYSTEM TROUBLE" LED.
- I. Drift Compensation, Analog Smoke Sensors:
1. System software shall automatically adjust each analog smoke sensor approximately once each week for changes in sensitivity due to effects of component aging or environment (i.e.: dust).
 2. Each sensor shall maintain its actual sensitivity under adverse conditions to respond to actual alarm conditions, while ignoring factors that generally contribute to nuisance alarms.
 3. System trouble circuitry shall activate, display "DIRTY DETECTOR" and "VERY DIRTY DETECTOR" indications and identify the individual unit that has been compensated beyond its acceptable limits.
- J. Analog Smoke Sensor Test:
1. System software shall automatically test each analog smoke sensor a minimum of 3 times daily.
 2. Test shall be a recognized functional test of each ionization chamber (analog ionization sensors) and photocell (analog photoelectronic sensors) as required annually by NFPA 72.
 3. Failure of a sensor shall activate system trouble circuitry, display a "Test Failed" indication, and identify the individual unit.
- K. Dual-Mode Walk Test:
1. The control unit shall provide a Dual-Mode Zoned Walk Test Program that shall enable an individual to test the Alarm/Supervision status of each sensor or module connected to system.
 2. During walk test, the control unit shall automatically reset after an alarm condition enabling the technician to continue testing the system without requiring a return to control panel.
 3. During an Audible walk test, placing a device in alarm shall cause 4 pulses on the notification appliance circuits. Operation of a supervisory switch shall cause 3 pulses, while removal or disconnection of an initiating device shall cause 2 pulses. All tests shall be recorded by the printer for reference.
 4. The silent walk test shall record all tests by printer for reference, while not activating notification appliance circuit(s).
- L. Printed Circuit Boards, Control Panel Components:
1. The control unit shall be housed in a steel cabinet.
 2. All groups of circuits or common equipment shall be clearly marked.
 3. The control unit shall be red in color and shall include the following features:
 - a. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15 percent of normal ("brown out" conditions). This circuit shall allow batteries to be effectively "floated" on the operating system to avoid upsetting normal microprocessor operation and minimize resultant

nuisance troubles and/or alarms. This circuit shall be physically isolated from the power supply to facilitate service.

- b. Ground fault detector to detect positive or negative grounds on signaling line circuits, notification appliance circuits, and power circuits. Ground fault indication shall occur on display and general trouble devices shall operate as specified herein, but shall not cause alarm.
- c. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, and notification appliance circuits. Systems that require an optional module to provide this protection shall not be considered equal.
- d. Individual overcurrent protection shall be provided for the following: smoke detector (resettable) power, main power supply, battery standby power, and auxiliary (non-resettable) output.
- e. Common reset and lamp test switch, labeled "SYSTEM RESET/LAMP TEST" shall be provided on panel.

M. City Connection:

- 1. The fire alarm system shall be connected via Digital Alarm Communicator Transmitter (DACT) over telephone lines to a central station or remote station.
- 2. The fire alarm system shall be equipped with a Cellular Dialer to connect to a central station or remote station.
- 3. The panel shall contain a disconnect switch to allow testing of the system without notifying the fire department.

N. Remote Station Option:

- 1. The fire department shall be consulted as to the authorized remote station serving the municipality.
- 2. The fire alarm system shall transmit both alarm and trouble signals with the alarm having priority over the trouble signal.
- 3. The contractor shall be responsible for installation charges, while the owner shall be responsible for line lease charges.

O. Central Station Option:

- 1. The fire alarm control panel shall provide an integral Digital Alarm Communicator Transmitter (DACT) for signaling to a Central Station. The DACT shall contain a "Dialer-Runaway" feature preventing unnecessary transmissions as the result of intermittent faults in the system and shall be Carrier Access Code (CAC) compliant, accepting up to 20-digit central station telephone numbers.
- 2. The fire department shall be consulted as to the authorized central station companies serving the municipality.
- 3. The fire alarm system shall transmit both alarm and trouble signals with the alarm having priority over the trouble signal.
- 4. The contractor shall be responsible for installation charges, while the owner shall be responsible for line lease charges.

1.8 CONTRACTOR QUALIFICATIONS

- A. The installing contractor shall be the authorized representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the fire alarm manufacturer's product for at least three years.
- B. The installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
- C. The installing contractor shall have on his staff an installation technician licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
- D. The installing contractor or equipment supplier shall have on staff a minimum of two (2) certified NICET Level III state licensed fire alarm planning superintendents under whose supervision system design shall take place. In lieu of an alarm planning superintendent, the contractor may provide design supervision by a registered professional engineer.
- E. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- F. The installing contractor must have a permanent office within a 100 mile radius of the project site and be a approved dealer/integrator, of the proposed system, in the nearest major metropolitan area.
- G. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems in the surrounding area for at least ten (10) years.
- H. All individuals installing the fire alarm system must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
- I. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing fire alarm system contractor will be allowed for any portion of the fire alarm system scope of work.
- J. Acceptable manufacturers:
 - 1. The system specified shall be that of Edwards EST.
 - 2. No other manufacturers shall be accepted.

1.9 ACCEPTABLE MANUFACTURER

- A. All fire alarm system devices and equipment shall be manufactured by Edwards Systems Technology, EST. No other manufacturers will be accepted.
- B. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.
- C. All equipment provided shall be available for purchase from at least two authorized distributors within the service area.

1.10 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:

FIRE DETECTION AND NOTIFICATION SYSTEM

1. Control panel wiring and interconnection schematics.
 2. Complete point to point wiring diagrams.
 3. Complete floor plan drawings locating all system devices.
 4. Factory data sheets on each piece of equipment proposed.
 5. Detailed system operational description.
 6. Complete system bill of material.
 7. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 8. Location of sleeved wall pass-thru
 9. Size of sleeve at each location installed
 10. Quantity of cable passing through each sleeve
- B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.
- C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices may not be shown. It is the contractor's responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein to provide a complete operational system as specified.
- D. Specification Compliance: A letter shall be provided stating, by section and subsection, that the fire alarm system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- E. Drawing Compliance: A letter shall be provided stating that the fire alarm system installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- F. Certifications/Licensing: The contractor shall submit all of the following certifications/licensing and the all must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.
1. State Fire Alarm License
 2. Manufacturer's Authorized Dealer Certification
 3. NICET Level III certification (1 for each required)
 4. Manufacture Installer Training Certificate (required for at least 25% of all installers on site.)
- G. Fire Alarm Close Out requirements
- a. Service and maintain fire alarm system for one year from the date of project substantial completion. Clean and adjust equipment as per manufacturer recommendations. Provide scheduled maintenance tasks to keep system warranty in effect.
 - b. Provide documentation of all preventive maintenance and service calls.
 - c. Provide training to CISD personnel at completion of project.
 - d. Provide fire alarm close out documents and fire alarm panel programming to CISD Life Safety Dept.

- e. Provide backup copy of panel programming to CISD Maintenance.
- f. Perform annual test (NFPA 72 Fig 7-5.2.2 testing and inspection form) during final month of warranty period to certify complete operating system.
- g. Provide one (1) Allen resetting wrench or key per pull station installed.
- h. Provide six (6) keys of each type of device.
- i. Provide three (3) detectors of each type installed on project for attic stock.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in a clean, dry area indoors in accordance with the manufacturer's instructions.
- C. Handling: Protect materials from damage during handling and installation.

1.12 INTERFACING

- A. Coordinate the Work of this section with the Work of other sections for purpose of interfacing to building systems as required on the Drawings, including but not limited to, elevator interface, HVAC interface, and security system interface.

1.13 COORDINATION

- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with **ALL** other trades.

PART 2- PRODUCTS

2.1 MANUFACTURER

- A. The specified and approved equipment manufacturer is Edwards Systems Technology (EST).
- B. All Fire Alarm Systems shall be manufactured one manufacturer.
- C. The district reserves the right to reject or deny the use of any product or service provider if they do not meet our standards for product or installation methods. We also reserve the right to reject any installer based on past performance in the district or with other school districts in the nearest, major metropolitan area.
- D. The Following Panels will be used for this project's applications.
 - 1. Edwards EST4, voice evacuation system.

2.2 GENERAL

- A. All equipment furnished for this project shall be new and unused. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on contract drawings and installation specifications shall be the best suited for the intended use and shall be the product of a single manufacturer.

2.3 SYSTEM OVERVIEW:

- A. The Fire Alarm / Life Safety System shall be a microprocessor based system designed specifically for smoke and fire detection applications. The Fire Alarm / Life Safety System shall be UL listed under Standards 864 (*Control Units for Fire-Protective Signaling Systems*) under category UOJZ.

2.4 PANEL COMPONENTS AND FUNCTIONS

- A. General
1. The control panel shall be a multi-processor based system designed specifically for fire and releasing system applications. The control panel shall be listed and approved for the application standard(s) as listed under the General section.
 2. The control panel shall include all required hardware, software and system programming to provide a complete and operational system. The control panel shall assure that life safety takes precedence among all panel activities.
 3. The control panel shall include the following capacities:
 - a. Support up to 1000 analog/addressable points plus 48 conventional circuits.
 - b. Support up to 8 fully supervised remote annunciators.
 - c. Support digital dialer (DACT) with multiple communication protocols
 - d. Support up to 1000 chronological events.
 4. The control panel shall include the following features:
 - a. Provide electronic addressing of analog/addressable devices.
 - b. Provide an operator interface display that shall include functions required to annunciate, command and control system functions.
 - c. Provide an internal audible signal with different programmable patterns to distinguish between alarm, supervisory, trouble and monitor conditions.
 - d. Provide a discreet system control switch provided for reset, alarm silence, panel silence, drill switch, up/down/right/left switches, status switch and help switch.
 - e. Provide system reports.
 - f. Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
 - g. Provide an authorized operator to perform test functions within the installed system.
 - h. All system programming and history shall be permanently stored in non-volatile memory to ensure that no programming or history is lost. Systems which store initial programming or field programming changes in battery backed memory will not be accepted.
 5. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display.
 6. Software and processor operation shall be independently monitored for failure. The system shall provide fail-safe operation, with a backup level of system operation.
 7. A compare utility shall identify programming and device changes on the system.
- B. Operators' Interface:
1. A Liquid Crystal Display (LCD) shall provide the means to inform the system operator with detailed information about the off-normal status of the installed Fire Alarm / Life Safety System. The LCD shall automatically respond to the status of the system, and shall display that status in 224-character front panel display.
 2. The following status functions shall be annunciated by the LCD Display:

- a. When the Fire Alarm / Life Safety System is in the "Normal" Mode, the panel shall display: current date and time, a two-line custom system title, and a summary total of system events.
 - b. With the Fire Alarm / Life Safety System is in the off-normal mode, the LCD display shall automatically reconfigure into three logical areas.
 - c. Panel Status Area - The LCD shall show the system time, the number of active points, and disabled points in the system.
 - d. Event Area - The LCD shall show the first two active events of the highest priority
 - e. Type Status Area - The LCD shall show the total number of active events in the system, by the following event types: "Alarm Events", "Supervisory Events", "Active Trouble Events", and "Active Monitor Events".
- C. Addressable Device Controller:
1. A 100% digital loop controller shall be provided in the Fire Alarm / Life Safety System panel to interface with the intelligent microprocessor-based detectors and modules.
 2. It shall be possible to connect the loop controller to the detectors and modules using any wiring material or method complying with Chapter 3 of the National Electrical Code without the need for special shielding, twisted wire, or conduits. The loop controller shall be capable of supporting Class A (Style 7) or Class B (Style 4) circuits without the need for additional hardware modules. It shall be possible to wire multiple branch circuits (T-Taps) from Class B Circuits (Style 4).
 3. The loop controller shall be capable of setting the address of all Intelligent microprocessor-based devices connected to it electronically, without the need to set switches at any of the individual devices.
 4. The loop controller shall provide a minimum of 6 types of supervision for each smoke detector on the circuit:
 - a. Device location
 - b. Unexpected device add/Delete
 - c. Missing device address
 - d. Changes in the physical wiring of the circuit
 - e. Changes in device settings
 - f. Device maintenance alert
 5. The loop controller shall determine the electrical location of each connected detector and module. The location and type of each connected device shall be mapped and stored in memory in the loop controller. It shall be possible to access and display this map.
 6. It shall be possible to obtain a mapping report of all devices connected to the loop controller for confirmation of "as-built" wiring. The mapping report shall show the electrical relationship of all connected devices, including T-Taps, device types, and the panel addresses of devices on the circuit. The loop controller shall be capable of reporting any additional device addresses, which may have been added to the circuit, and/or changes that may have been made to the wiring in the data circuit. A specific trouble shall be reported for any and all off-normal non-alarm condition.
 7. The loop controller shall notify the system when any connected smoke detector reports a "routine maintenance required" signal to the system.
- D. Notification Appliance Circuits:
1. Provide as indicated on the plans, supervised hard-wired Notification Appliance Circuits (NAC) for the control of 24Vdc notification appliances. Each NAC shall operate as Class B (Style Y) power limited circuit.
 2. NAC's shall be capable of providing steady, 20bps, 120bps or temporal rate outputs.

3. Provide Notification Appliance Circuits to accommodate all new and existing devices and/or circuits.
- E. Power Supply
1. Each system power supply shall be a minimum of 6 amps @ 24 vdc.
 2. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any alarm, trouble or operator acknowledgment signals.
 3. Each system power supply shall be annunciated individually as a shall annunciate as a trouble signal, identifying the inoperable power supply(ies).
 4. All standby batteries shall be continuously monitored by the system. Low battery and disconnection of battery power supply conditions shall immediately annunciate as a trouble signal, identifying the deficient batteries.
 5. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.
- F. Dialer (Digital Alarm Communicator Transmitter – DACT)
1. The system shall provide an off premise communications module capable of transmitting system events to multiple primary and secondary central monitoring station monitoring station receivers.
 2. The system module shall provide multiple monitoring station receiver formats capable of transmitting up to 8 subscribers.
 3. The system shall be capable of transmitting point information via Contact ID or SIA 4/2 protocols.
 4. The Dialer shall be capable of communications with an E24 monitoring company. Provide programming, verification and testing with owner's service using actual account number.
 5. The system shall be equipped with a Cellular Dialer for wireless cellular communications.
- G. System Reports
1. The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, and shall be capable of being printed on the system printer.
 2. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 80% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
 3. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on the system, or any given analog/addressable device circuit.
 4. The system shall provide a report that gives a chronological listing of up to the last 1000 system events.
 5. The system shall provide a listing of all of the firmware revision listings for all of the installed components in the system.

2.5 LIFE SAFETY SYSTEM PROGRAMMABLE OPERATIONS:

- A. The routing of all system annunciation and control parameters shall be configurable to any or all remote annunciators on the system manually, or automatically as a function of the time of day or date.

- B. The system printer, if required, shall be configurable to display any combination or all of the following functions: Alarm, Supervisory, Trouble, and Monitor events.
- C. Each remote annunciator connected to the panel shall be configurable to show the status of any combination or of Alarm, Supervisory, Trouble, Monitor functions pertaining to any point in the system.
- D. Each point in the system shall be labeled with up to a 36 character custom message.
- E. System shall have the capability to provide logical "Counting AND" Groups and "Matrix Groups. Each matrix group shall be programmable by radius and activation number.
- F. System shall have the ability to define Service Groups. A Service group shall consist of any addressable field device and shall not be defined or limited by the physical layout of the Fire Alarm / Life Safety System, or its application to the protected premises. The system shall include the ability to define an alternate set of device commands which may be used in combination with the system test command and service groups for the testing of the connected intelligent microprocessor based devices.
- G. The system shall include Time Control functions that have the ability to control any system output or system operational sequence as a function of the month, day of week, date, hour, minute, or holiday.
- H. The system shall support software defined Logical Zone Groups which may group any input from any initiating device circuit, in order to control a system output or function, or initiate any system operational sequence. A device or IDC may be a member of one Zone.
- I. The system shall have the ability to download data from the intelligent devices to a PC while the system is on-line and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.
- J. All final panel programming shall be configured as per final room number designation as identified by actual building room numbers, not architectural room numbers listed on construction set. **It is the contractor's responsibility to acquire the correct building room numbers.**

2.6 FIELD MOUNTED SYSTEM COMPONENTS:

- A. Analytical Microprocessor-based Detectors - General:
 - 1. System shall use Analytical Microprocessor-based Detectors that are capable of full digital communications with the Fire Alarm / Life Safety System using both broadcast and polling communications protocols. Each detector shall be capable of performing independent advanced fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns, and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted nuisance alarms caused by environmental events. Signal patterns that are not typical of fires shall be eliminated by digital filters and shall not cause a system alarm condition. Devices not capable of combining different fire parameters or employing digital filters will not be acceptable.
 - 2. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector's memory. Detectors not capable of making independent alarm decisions are not acceptable.

3. Each detector shall have a separate means of locally displaying system communication and detector alarm status. A different LED indication for alarm and trouble shall be provided (devices in which the LED does not flash in supervisory mode are not acceptable).
 4. Each detector shall be capable of identifying diagnostic codes to be used for system maintenance. All diagnostic codes shall be stored in the detector. Each smoke detector shall be capable of transmitting pre-alarm, alarm, and maintenance signals to the Fire Alarm Control Panel via the Loop Controller.
 5. Each detector microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient "Environmental Thresholds" continually and periodically. In this manner, the environmental impact of temperature, humidity, environmental contaminants as well as detector aging shall be automatically monitored and adjusted for. This process shall employ digital compensation techniques to adapt the detector to both long term and short term changes in the environment in which they are installed. The microprocessor shall monitor this environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the derived base line sensitivity that the detector has sensed in its environment. The base line sensitivity information shall be automatically and periodically updated and permanently stored in the detector.
 6. Each detector shall be capable of automatic electronic addressing and/or custom addressing, without the use of DIP or rotary switches, and shall mount on a common base to allow the simple replacement of one detector type with another detector type. The addressing of the detectors shall not depend on the electrical position of the detector in the circuit.
 7. If devices require DIP or rotary switches for addressing, every device shall be physically removed and verified during final checkout with engineer to confirm devices are located and programmed correctly. All switch addressed devices and their bases must be labeled with engraved plastic labels to identify device address and intended location. Labels shall have a red background with white letters, letters shall be a minimum of 1/4" in height.
- B. Detectors - Photoelectric Smoke Detector, (Duct Detector Use)
1. Photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to detect visible particulates produced by combustion. The integral microprocessor shall dynamically examine values from the sensor and initiate a system alarm based on the analysis of data. Detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. Information shall be stored in the detector's memory and shall be transferred to the electronic loop controller for retrieval using a laptop PC or the Intelligent Detector Program/Service Tool designed by the manufacturer specifically for the purpose.
 2. The fire alarm contractor is responsible for reviewing the mechanical drawings for locations of all ductwork to identify where duct smoke detectors are required to be installed.
 3. The alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5% smoke obscuration per foot. The photo detector shall be suitable for operation in the following environment:
 - a. Temperature: 32°F to 120°F (0°C to 49°C)
 - b. Humidity: 0-93% RH, non-condensing
 - c. Elevation: no limit
- C. Duct Detector Housing:

1. The Analytical Microprocessor-based photoelectric smoke detector shall be readily adaptable for use in air duct smoke detection applications, using a housing that mounts to the outside of the duct. When used for duct smoke detection, the smoke detectors will not forfeit any of the system functionality that they have when used as area smoke detectors.
 2. The duct smoke detection housing shall allow the detector to sample and compensate for, variations in duct air velocity between 300 and 4,000 feet per minute.
 3. Remote alarm LEDs and Remote Test Stations shall be supported by the duct smoke detector and provided where indicated.
 4. All detectors used in duct applications shall be located in accordance with NFPA 72 recommendations.
 5. Contractor shall be responsible for repairing the duct work in areas where new devices do not fit the existing locations.
- D. Detectors - Fixed Temperature/Rate of Rise Heat Detector
1. Heat Detector shall have a solid state heat sensor, and shall transmit an alarm at a fixed temperature of 135° F (57°C) or due to a temperature Rate of Rise of 15°F/minute (9°C/minute). The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
 2. The heat detector shall be rated for ceiling installation at 70 ft (21.3m) centers and be suitable for wall mount applications.
 3. Detectors - Fixed Temperature Heat Detector,
 4. Heat detector shall have a solid-state heat sensor, and shall transmit an alarm at a fixed temperature of 135° F (57°C). Detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
 5. Heat detector shall be rated for ceiling installation at 70 ft (21.3m) centers and be suitable for wall mount applications.
 6. Detectors - Mounting Bases
 7. Mounting base will not contain any electronics, shall support all Microprocessor-based Smoke detector types detailed in this specification, and have the following minimum requirements:
 - a. Removal of the respective detector shall not affect electronic loop communications with other detectors on that loop.
 - b. Field Wiring Connections shall be made to the room side of the base, so that wiring connections can be made or disconnected by the contractor without the need to remove the mounting base from the electrical box.
 - c. Bases will have the option of external LED operation, Relay base or data line isolator base.
 - d. Relay bases shall mount in a standard electrical box described above and provide Form "C" contacts rated at 1 amp @ 30VDC and listed for "pilot duty".

2.7 MICROPROCESSOR-BASED INTELLIGENT MODULES – GENERAL

- A. Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable modules for the monitoring and control of system Input and Output functions over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators.
- B. The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code.

Simply changing the associated personality code may change module operation at any time.

- C. All addressing of the Microprocessor-based Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be dependent on their electrical location on the circuit.
- D. All Microprocessor-based Addressable Modules shall have a visual means to confirm communications with the panel, and a visual means to confirm the alarm status of the modules.
- E. All field wiring to the Microprocessor-based Addressable Modules shall be supervised for opens and ground faults and shall be location identified to the module of incidence.
- F. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Modules to assist in troubleshooting system faults.
- G. The module shall be suitable for operation in the following environment:
 - 1. Temperature: 32°F to 120°F (0°C to 49°C)
 - 2. Humidity: 0-93% RH, non-condensing
- H. Single Input Module:
 - 1. Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class B (style B) input circuit capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.
- I. Dual Input Module:
 - 1. Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class B (style B) input circuits capable of operating with two (2) contact devices. Both of the input circuits shall be terminated to, and operated from, the same microprocessor-based addressable module. The Initiating Device Circuit connected to the module shall be fully supervised for open circuits and ground faults.
 - 2. Modules shall report the operation of Waterflow Switches. The modules shall have an automatic delay of 15 seconds before reporting the Waterflow alarm condition to the Fire Alarm Control Panel. Module shall monitor sprinkler supervisory switches. The module shall automatically report the supervisory function to the Fire Alarm Control Panel each time the associated dry contact closes. Refer to project sprinkler drawings for sprinkler riser locations and quantities.
- J. Single Riser Signal Module:
 - 1. The Microprocessor-based Addressable Single Input Signal Module shall provide one (1) supervised Class B (style Y) Notification Appliance Circuit capable of a controlling 2A of polarized 24 VDC Notification Appliances.
- K. Control Relay Module:
 - 1. Microprocessor-based Addressable Control Relay Modules shall provide one form "C" dry relay contact rated at 2 amps @ 24 Vdc or 0.5 amps at 120 VAC to, control external appliances or equipment processes. The control relay module

shall be rated for pilot duty applications and releasing systems service. The position of the relay contact shall be confirmed by the system firmware.

- L. Microprocessor-Based Addressable Manual Pull Stations
 - 1. Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable Manual Pull Stations connected over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All Manual Pull Stations shall display communications and alarm status via integral LED's.
 - 2. All addressing of the Microprocessor-based Addressable Manual Pull Stations shall be done electronically, and the electrical location of each station shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the Manual Pull Station will not be dependent on their electrical location on the circuit.
 - 3. All field wiring to the Microprocessor-based Addressable Manual Pull Stations shall be supervised for opens and ground faults. All ground faults shall be location identified to the module of incidence.
 - 4. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Manual Pull Stations to assist in troubleshooting system faults, including ground faults on the device.
 - 5. Manual Fire Alarm stations shall be double action and shall be supplied with a Safety Technology International, Inc., STI-1100 Stopper II protective cover with self-contained horn.

2.8 FIRE ALARM NOTIFICATION APPLIANCES - GENERAL REQUIREMENTS

- A. All appliances which are supplied for the requirements of this specification shall be UL Listed for Fire Protective Service, and shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA(AG)), and shall be UL 1971 Listed.
- B. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturer's instructions.
- C. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended. All strobes shall be provided with lens markings oriented for wall mounting. It shall be possible to replace the lens of any installed strobe in order to facilitate the replacement of a broken lens, or to change the orientation of the lens markings. Removal of an installed strobe to facilitate the changing of a lens will not be acceptable.
- D. All appliances installed in gymnasiums shall be equipped with a wire-guard protective cover. American Wire Guards brand, or equivalent.
- E. Speaker/Strobes
 - 1. Provide low profile white wall mount horn/strobes at the locations shown on the drawings. The Speaker/Strobe shall provide an audible output of 90 dBA at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd. &

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110cd devices. The horn shall have a selectable steady or synchronized temporal output. In and Out screw terminals shall be provided for wiring. Low profile horn/strobes shall mount in a North American 1-gang box.

- F. Strobes
 - 1. Provide low profile ceiling mounted white strobes at the locations shown on the drawings. In and out screw terminals shall be provided for wiring. Strobes shall provide synchronized flash outputs. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd, or 110cd devices. Low profile strobes shall mount in a North American 1-gang box.
- F. Remote LCD Annunciators:
 - 1. Remote LCD annunciators shall have the full ability and duplicate all functions of the main user interface located on the control panel. This includes the ability to control all system functions and duplicate panel annunciation.
 - 2. Annunciator shall also include the ability to support programmable switches and or LED's as required for special functions with out the need to add additional wires or cabinets.

2.9 ADDITIONAL EQUIPMENT

- A. Contractor shall include in their pricing, the cost to furnish and install the following additional equipment. These devices shall be used to fulfill any changes request issued until the list is depleted. Upon the completion of the project, all remaining material shall be delivered to the project for owner stock. No devices shall be used without documentation and written authorization from the project's technology consultant. Contractor shall obtain a signed transmittal of additional equipment to the owner at the end of the project. The signed transmittal shall be included in the contractor's closeout documents.
- B. Additional Equipment List:
 - 1. (15) Ceiling Mounted Audiovisual Strobes
 - 2. (15) Ceiling Mounted Visual Strobes
 - 3. (5) Manual Pull Stations
 - 4. (5) Stopper II tamper deterrent covers
 - 5. (3) Duct Detectors with sample tube and LED notification device
 - 6. (20) Ceiling Mounted, Photoelectric Smoke Detectors with base
 - 7. (10) Ceiling Mounted, Fixed Temperature, Heat detectors with base
 - 8. (8) Sets of keys to the FACP front locking panel

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The complete system shall be installed by one (1) contractor and the installing contractor must be a certified dealer of the specified system. **NO SUBCONTRACTORS, TO THE AWARDED PROPOSING CONTRACTOR, WILL BE ALLOWED TO INSTALL ANY PORTION OF THIS SYSTEM.** Including, but not limited to:
 - 1. Wiring
 - 2. Field device installation
 - 3. System programming
 - 4. FACP installation
 - 5. Remote power supply installation

- B. The installing contractor shall install the network fire alarm system in as instructed by the manufacturer's instructions.
- C. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- D. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- E. Manual pull stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.
- F. Smoke detectors shall be properly protected throughout construction.
- G. Wiring:
 - 1. **ALL WIRE ASSOCIATED WITH THE FIRE ALARM SYSTEM SHALL BE NEW AND RED IN COLOR ON THE ENTIRE PROJECT. NO EXCEPTIONS.**
 - 2. All wiring shall be in accordance with NFPA 72, the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
 - 3. All wire shall be U.L. Listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or MPP wire may be run open in return air ceiling plenums provided such wire is U.L. Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
 - 4. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.
 - 5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and support a minimum wiring distance of 10,000 feet when sized at 12 AWG. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit. Shielded wire shall not be required.
 - 6. All field wiring (with exception of external communications Ethernet) shall be electrically supervised for open circuit and ground fault.
 - 7. Minimum wire sizes shall be as follows:
 - a. Initiating Zones: 18 AWG
 - b. Indicating Zones: 14 AWG
 - c. Relay Control Circuits: 18 AWG
 - 5. The fire alarm control panel shall be capable of T-tapping NFPA Style 4 (Class B) Signaling Line Circuits (SLCs). Systems which do not allow or have restrictions in, for example, the amount of T-taps, length of T-taps etc., is not acceptable.
 - 6. Contractor shall ensure that all exterior horn locations will be installed in a weatherproof enclosure and sealed watertight. It is the contractor's responsibility that the conduit and box be installed in a manner that allows the device to be securely installed at all exterior locations and provide waterproofing as required to protect device and wiring.
 - 7. Fire alarm system dialer shall be installed in accessible location near main fire alarm panel. Dialer shall be installed in its own panel box. Dialer shall be a Notifier 411 series. Dialer shall be powered from 24vdc source from the Notifier panel.
 - 8. Contractor shall provide a service loop located above each device installed on the entire project. The service loop shall be a minimum of 5'.
 - 9. Contractor shall provide a service loop located above each type of panel installed. The service loop shall be a minimum of 10', but shall have enough

- length to allow for the panel to be relocated to any wall within the room that panel is located in.
10. All service loops shall be installed in the accessible ceiling that is nearest to each device and panel. No service loops shall be installed in open spaces or non accessible spaces.
- H. Terminal Boxes, Junction Boxes and Cabinets:
All boxes and cabinets shall be UL listed for their use and purpose.
- I. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod. The control panel enclosure shall feature a quick removal chassis to facilitate rapid replacement of the FACP electronics.
- J. Cable Support:
1. All wire not installed inside conduit shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
- a. Approved Cable Support Product:
PANDUIT® Corporation J-MOD™ modular support system
1. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount support hook to the treaded rod.
2. cable support shall be installed at a maximum of 5' on center.
3. All cable installed shall be attached to the support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the fire alarm panels as required to manage the wires within each type of panel.
4. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
5. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.**
- K. Conduit / Raceway:
1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC, local, and state requirements.
3. Minimum conduit size shall be 3/4" (19.1 mm). Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or

subject to damage.

5. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
6. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.
7. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
8. Conduit shall not enter the fire alarm control panel or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.
9. All wiring associated with smoke control system shall be installed in conduit per current adopted codes regardless of voltages or ratings.

3.2 TEST AND REPORTS

A. Test:

1. The service of a state licensed, factory trained NICET level II technician shall be provided to technically supervise and participate during all of the adjustments and tests for the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
2. All testing shall be in accordance with NFPA 72, Chapter 10.
3. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
4. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
5. Verify activation of all water flow switches.
6. Open initiating device circuits and verify that the trouble signal actuates.
7. Open and short signaling line circuits and verify that the trouble signal actuates.
8. Open and short notification appliance circuits and verify that trouble signal actuates.
9. Ground all circuits and verify response of trouble signals.
10. Check presence and audibility of tone at all alarm notification devices.
11. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
13. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
14. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision. Any items found not properly installed or non-functioning shall be replaced or repaired and retested.
15. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed

fire alarm superintendent responsible for supervising the final system test and checkout.

B. Final Inspection:

1. The installing contractor's state licensed, factory trained NICET level II technician shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections as may be required by the local authorities.

C. Closeouts:

1. It is the intent of these specifications and of the architect/engineer that a continued program of system maintenance be continued by the owner in compliance with NFPA Standard 72H. It is mandatory that the installing contractor provide such services and make available these services to the owner upon completion of the project.
2. As part of the closeout documents, fire alarm contractor will provide owner with AutoCAD asbuilt drawings indicating locations of devices, routing of wiring, and panel information. All room numbers indicated on final close out documents and all panel settings shall be listed by actual building room numbers and not by room number indicated on construction documents. CAD files shall be AutoCAD 2017 or later. Provide the owner with one Mylar plot of each drawing and two blue line prints of each drawing.
3. Provide the owner with electronic versions of the as-built CD's.
4. Locate next to building FACP and fire alarm annunciator panel
5. A building graphic shall be provided mounted in aluminum-extruded frame with plexi-glass front. Graphic shall locate all fire alarm devices, power supplies, and FACP.
6. State FML-005 certificate shall also be framed and mounted near the fire alarm panel. Fire alarm panel shall have white FM required installation sticker attached to it.
7. Graphic shall include actual room numbers posted as part of the building graphics package, include as part of substantial completion requirement.

3.3 WARRANTY

- A. The fire alarm system, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.
- B. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

3.4 FUNCTIONS

A. Alarm System Automatic Functions:

1. Upon the operation on any sprinkler flow switch, manual pull station, or detector:
 - a. Signal the Fire Alarm Control Panel. Identify the addressable point at the Fire Alarm Control Panel and the remote fire alarm annunciator.
 - b. Sound a distinctive evacuation signal throughout the entire building.
 - c. Simultaneously activate all flashing visual alarm assemblies associated with audible indicators.
 - d. Shut down all mechanical equipment rated 2000 cfm or greater that circulate air for that floor. This equipment shall include, but shall not be limited to, air handling units, ventilation fans, fan powered boxes, and

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- side pocket boxes. Coordinate with Division 15 Specification Section Air Conditioning Controls as required for passive smoke control.
- e. Close all smoke control dampers. Provide control relay within three (3) feet of each damper or power supply for motor drives or fail-safe dampers. When fail-safe smoke dampers are powered in parallel from a common power circuit then fire alarm relay may be provided to interrupt common power circuit; separate relay not necessary at every such damper. Install supervised fire alarm wiring from relay to fire alarm control panel. Resetting fire alarm system shall include opening smoke control dampers.
 - f. Activate and automatic telephone dialer and alarm contact closure for use with approved central station monitoring service. Owner provides NFPA 71 central station connection and maintains that service.
 - g. Release all fire and smoke control doors on hold-open devices so that doors may close.
 - h. Kitchen:
 - 1) Operation of any kitchen hood fire suppression system shall initiate the alarm building fire alarm control panel. Building fire alarm system shall sound alarm over appropriate notification appliance circuits as required by NFPA 72 sect. 3-8.8.1. Comply with NFPA 96 Standard for Commercial Cooking Operations, sect. 7-3.1.4. Actuation of a dry chemical shall cause building fire alarm per NFPA 17 sect. 3-7.4. Actuation of a wet chemical system shall cause building fire alarm per NFPA 17 sect. 3-2.1.5
 - i. Sprinkler System:
 - 1) Operation of any sprinkler system water flow switch shall activate the sprinkler alarm bell.
 - j. All alarm signals shall continue sounding and annunciator(s) shall remain lighted until the alarm acknowledged switch is depressed. The alarm signals shall then stop, but the annunciator shall remain lighted until the system is reset.
 - k. Acknowledging of any alarm signal shall interfere with the re-activating of the alarm signals upon an alarm from another zone.
 - l. Alarm Verification:
 - 1) Provide UL listed alarm verification feature.
 - 2) Alarm verification shall be per addressable, open area smoke detector. Alarm verification shall be field programmable on an individual detector basis. Global or dydte, alarm verification will be unacceptable.
 - 3) If an alarm condition is detected by an automatic smoke detector programmed for ALARM VERIFICATION, an alarm verification sequence shall be initiated. Upon receipt of the initial alarm condition, start the verification sequence as prescribed by UL 864. The system shall rest the alarmed zone/device within the UL prescribed window of 60 seconds maximum. If the alarm condition does not confirm within 60 seconds of the reset signal, the programmed alarm outputs shall be canceled and the system returned to the normal mode. If the alarm condition re-occurs within the designated verification cycle or a non-verified device or zone activates, the programmed events listed above shall immediately occur for the confirmed alarm condition.
 - 4) Alarm verification shall not be used for any spaces programmed to required two smoke detectors to initiate an alarm response (ex. elevator lobbies), per NFPA 72-1993 Sect. 3-8.2.5.

3.5 WALK TEST

- A. Notify Owner, Architect and Engineer when system is 100 percent operational. Schedule walk-through of the entire facility and verify that each initiating and each indicating device is operating properly.
- B. Provide report at conclusion of walk through certifying all fire alarm devices are working.
- C. Walk test shall include a representative from owner maintenance department.
- D. Walk test to show in a printed report all AHU shutdown, Sprinkler Tamper Report, Sprinkler Flow switch, strobes/horns, and smoke detectors. Report shall list all devices by approximate location to rooms, and device number. All duct detectors shall include flow differential at the detector as measured by a manometer. Manometer reading shall match manufacturer's specification for duct detector used.

3.6 SOFTWARE

- A. Installer shall provide a backup copy of the installed program database on CD media and 8GB thumb drive upon completion of the project.
- B. Provide the current version of system software, for the panel provided, on CD and 8GB thumb drive.
- C. Install additional CDs and 8GB thumb drives containing the installed program database, framed under plastic at the FACP and each annunciator panel.

END OF SECTION 28 31 00

28 49 00 – PERSONAL VAPORIZER DETECTION SYSTEM

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. General Requirements

1. The specified unit shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
2. The specified unit shall be based upon standard components and proven technology using open and published protocols.

B. Sustainability

1. The specified unit shall be manufactured in accordance with ISO 9001.
2. The specified unit shall be compliant with the EU directives 2011/65/EU (CE).
3. The specified unit shall be compliant with the EU regulation 1907/2006 (REACH).
4. The specified unit shall be Halogen-free in accordance with IEC 61249-2-21.

1.02 CERTIFICATIONS AND STANDARDS

A. General abbreviations and acronyms

1. AES: Advanced Encryption Standard
2. API: Application Programming Interface
3. AQI: Air Quality Index
4. Aspect ratio: A ratio of width to height in images
5. BACnet: Building Automation and Control (BAC) Network
6. Bit Rate: The number of bits/time unit sent over a network
7. Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
8. DHCP: Dynamic Host Configuration Protocol
9. DNS: Domain Name System
10. FPS: Frames per Second
11. FTP: File Transfer Protocol
12. IEEE 802.1x: Authentication framework for network devices
13. HTTP: HyperText Transfer Protocol
14. HTTPS: Hypertext Transfer Protocol Secure
15. IAQ: Indoor Air Quality
16. IP: Internet Protocol
17. ISO: International Standards Organization
18. LAN: Local Area Network
19. LED: Light Emitting Diode
20. MPEG: Moving Picture Experts Group
21. MJPEG: Motion JPEG (M-JPEG or MJPEG) is a video compression format in which each video frame or interlaced field of a digital video sequence is compressed separately as a JPEG image.
22. Multicast: Communication between a single sender and multiple receivers on a network
23. NTP: Network Time Protocol

24. PoE: Power over Ethernet (IEEE 802.3af Class 3 Compliance, 80 mA) standard for providing power over network cable
 25. QoS: Quality of Service
 26. RTSP: Real Time Streaming Protocol
 27. SMTP: Simple Mail Transfer Protocol
 28. SNMP: Simple Network Management Protocol
 29. SSL: Secure Sockets Layer
 30. TCP: Transmission Control Protocol
 31. TLS: Transport Layer Security
 32. Unicast: Communication between a single sender and single receiver on a network
- B. The specified unit shall carry the following EMC approvals:
1. EN 55024:2010
 2. FCC 47 CFR Part 15 - Subpart B Class A
 3. EN 55032:2012 + AC:2013
 4. ICES-003 ISSUE 6:2016
- C. The specified unit shall meet the following product safety standards:
1. IEC / EN / CE / WEEE / UL 60950-1 / CUL 60950-1
- D. The specified unit shall meet the following standards
1. Networking:
 - a. IEEE 802.3af Class 3 Compliance, 125 mA)
 - b. IEEE 802.1X (Authentication)
 - c. IPv4 (RFC 791)
 - d. IPv6 (RFC 2460)
 - e. WiFi
 2. Mechanical Environment:
 - a. IEC/EN 62262
 - b. Vandal Resistance with at least an IK-10 rating

1.03 QUALITY ASSURANCE

- A. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.
- B. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, as proof of the knowledge.
- C. The specified unit shall be manufactured in accordance with ISO9001.

1.04 WARRANTY

- A. The manufacturer shall provide warranty for (1) one year and optional extended warranty for the sensor for a total period of three years.

PART 2 PRODUCTS

2.01 GENERAL

- A. Sensor shall be IP-based and comply with established network standards.
- B. Sensors shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.
- C. Sensors shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.

2.02 SENSOR SCHEDULE

- A. Sensors listed below shall be supplied by a single manufacturer.
- B. The sensor manufacturer and model numbers will be as follows:
 - 1. Halo 3C Smart Sensor (model # HALO-V3.00C)

2.03 SENSORS

- A. Interior mounted Smart Sensor
 - 1. Provide sensors in gang restrooms for all secondary campuses.
 - a. Contractor shall provide and install all mounting hardware for ceiling installation.
 - 2. The sensor shall meet or exceed the following design specifications:
 - a. Each sensor is connected from device back to nearest MDF/IDF closet via Category 6 data cabling back to campus network switch.
 - b. The sensor shall operate on an open source; Linux-based platform and include a built-in web server.
 - c. The sensor shall provide local database storage utilizing internal memory.
 - d. The sensor shall be manufactured with an IP30-rated, IK10 impact-resistant, polycarbonate casing.
 - e. The sensor certified to operate in plenum space.
 - 3. The sensor shall meet or exceed the following performance specifications:
 - a. Detection and measurement of
 - 1. Particulates Size 1 μm particulates $\mu\text{g}/\text{m}^3$
 - 2. Particulates Size 2.5 μm particulates $\mu\text{g}/\text{m}^3$
 - 3. Particulates Size 10 μm particulates $\mu\text{g}/\text{m}^3$
 - 4. Carbon Dioxide Equivalents
 - 5. Total Volatile Organic Compounds
 - 6. Carbon Monoxide
 - 7. Ammonia
 - 8. Temperature/Humidity
 - 9. Barometric Pressure
 - 10. Light Level
 - 11. Sound Levels
 - 12. Tamper
 - 13. Vape
 - 14. Vape THC

15. Spoken Keyword
16. Gunshot
17. Aggression
18. Masking / Spray Paint
19. Indoor Air Quality, AQI: Air Quality Index
- b. Scheduling
 1. Shall have day and time selection for notification of detection.
 2. Shall have the scheduling be adjustable separately for each detection type.
- c. Audio microphones
 1. Shall have (2) two microphones
 2. Sensor shall perform audio analysis only
 3. Sensor shall not record live audio stream
- d. LED Indicator Light
 1. The sensor shall have a multi-color LED indicator.
- e. Speaker
 1. The sensor shall have a speaker.
- f. Encoding of Data Screen
 1. The sensor shall support the following video encoding algorithms:
 - a. Motion JPEG encoding of 1 frame per second.
- g. Video Transmission
 1. The sensor shall allow for video to be transported over:
 - a. HTTP (Unicast)
 - b. HTTPS
 - c. RTSP
- h. User Interface
 1. Web server
 - a. The sensor shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP and HTTPS, without the need for additional software.
- i. IP addresses
 1. The sensor shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
 2. The sensor shall allow for automatic detection of the sensor based on UPnP and Bonjour when using a PC with an operating system supporting this feature.
 3. The sensor shall provide support for IPv4.
 4. The sensor shall provide support for IPv6.
- j. Event functionality
 1. The sensor shall be equipped with an integrated event functionality, which can be triggered by:
 - a. Sensor tampering
 - b. Manual Trigger/Virtual Inputs
 - c. Event threshold met
 2. Response to triggers shall include:
 - a. Relays Outputs
 1. (2) Two relay outputs

2. Normally Open or Closed
3. Rated at 48VDC at 1 amp
- b. Status Light
- c. Speaker
 1. Pre-Recorded Files
 2. Programmable
- d. Send notification, using HTTP, HTTPS, TCP, RTSP, or Email
- e. Send images, using FTP, HTTP, HTTPS, RTSP, network share or email
- f. Identification in data logs
- k. Protocol
 1. The sensor shall incorporate support for at least IPv4/v6, HTTP, HTTPS, SSL/TLS, TCP, ICMP, SMTP, DHCP, UPnP, ARP, DNS, NTP, RTSP, Bonjour.
 2. The SMTP implementation shall include support for SMTP authentication.
- l. Security
 1. The sensor shall be in compliance with California's law for IoT device cyber security, California Civil Code Section 1798.91.04.
 2. The sensor shall restrict access to the built-in web server by usernames and passwords at two different levels.
 3. The sensor shall have minimum user-name and password criteria requirements.
- m. Configurability
 1. Network system configuration and sequence of operation shall be programmed by Owner once system is installed.
 2. The sensor shall permit configuration of Event thresholds, time requirements, filters, and combinational Events. Built in test functions shall be provided.
 3. The sensor shall permit configuration live viewing elements, live viewing style/colors, and live viewing ranges
 4. Sensor shall permit configuration of Actions including lighting patterns and colors, audible alerts, relay outputs, Email alerts, SMS alerts, and TCP/IP socket alerts.
 5. Sensor shall permit configuration of user accounts, network parameters, SMTP connection parameters with built in test function.
- n. API support
 1. The sensor shall be fully supported by an API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third party applications.
- o. Installation and maintenance
 1. The sensor shall provide built-in means which allows the assignment of IP addresses, upgrade of firmware and backup of the sensor' configuration without use of external software.
 2. The sensor shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the sensor' configuration.
 3. Sensor shall provide means to restore configuration with selection of desired sections of configuration to be restored.
 4. The sensor shall allow updates of the software (firmware) over the network, using FTP, HTTP, or HTTPS.
 5. Sensor shall provide logging and means to download daily files of Events, System States, and System Operation.

6. The sensor shall accept external time synchronization from an NTP (Network Time Protocol) server.
 7. The sensor shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.
 8. Sensor shall provide a built-in complete system test that can be performed at any time.
- p. Hardware interfaces
1. Network interface
 - a. The sensor shall be equipped with one 10BASE-T/100BASE-TX Fast Ethernet-port using a shielded RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).
- q. Enclosure
1. The sensor shall:
 - a. Be manufactured with an IP30-rated, IK10 impact-resistant, polycarbonate casing.
 - b. Secure the outer cover with anti-tamper TORX screws
 - c. Be provided with self-locking mounting features for installation in materials up to $\frac{3}{4}$ " (19MM) in thickness.
- r. Power
1. Power over Ethernet IEEE 802.3af
- s. Environmental
1. Operate in a temperature range of 0 °C to +50 °C (+32 °F to 122 °F).
 2. Operate in a humidity range of 0–90% RH (non-condensing).

PART 3 EXECUTION

3.01 INSTALLATION

- A. The Contractors or subcontractors' main resources within the project shall carry proper professional certification or training issued by the manufacturer.
- B. The Contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.
- C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.
- D. All firmware found in products shall be the latest and most up to date provided by the manufacturer.
- E. All equipment requiring users to log on using a password shall be configured with individually unique password/passwords. No system/product default passwords shall be allowed.
- F. A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

SECTION #31 10 00 – SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

- A. This Section includes the following:
 - 1. Clearing and grubbing.
 - 2. Stripping and stockpiling topsoil.
 - 3. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
 - 1. Division 32 Section "Chain Link Fences and Gates" for temporary construction fencing.

1.3 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 3. Do not proceed with work on adjoining property until directed by Engineer.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control Drawings.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 TREE PROTECTION

- A. Reference 015639 "Tree and Plant Protection".

3.3 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.

- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer and Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches (450 mm) below exposed subgrade.
 - 4. Use only hand methods for grubbing within tree protection zone.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
 - 2. Do not stockpile topsoil within tree protection zones.
 - 3. Dispose of excess topsoil as specified for waste material disposal.
 - 4. Select subparagraph above or below.
 - 5. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION #31 10 00

SECTION 31 13 13.13 - WASTE MATERIAL DISPOSAL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 SCOPE

- A. Waste material disposal consists of disposal of trees, brush, vegetation, rubbish and other objectionable matter from operations such as clearing and grubbing, demolition, excavation, concrete placement and grading. Unless otherwise specified, the Contractor is responsible for removal and disposal of waste material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Specific products are not required. Use equipment and materials necessary to properly complete disposal of waste materials.

PART 3 - EXECUTION

3.1 DISPOSAL AREA

- A. Items noted on plans to be "removed" or "disposed" will be taken completely off the site.
- B. Concrete wash-out will become property of Contractor to be disposed of with other waste materials.

3.2 COMPACTION AND GRADING

- A. Level off waste material to an elevation 12 inches below final grade. Place excess topsoil on waste material in a layer not less than 12 inches thick and compact to the density of the surrounding area.

END OF SECTION 31 13 13.13

SECTION #31 20 00 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

- A. This Section includes the following:
 - 1. Subgrade course for pavements.
 - 2. Base material for asphalt paving.
- B. All earthwork to be performed and materials used shall be in accordance with the Geotechnical Engineering Report. In the event of a discrepancy between the above-referenced standards, the plans, and/or any portion of this specification section, the order of precedence will be the above-referenced report, the City Design Standards, and then these specifications. The Contractor shall contact the engineer in the event of a discrepancy.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Material: Course placed between the subgrade asphaltic concrete paving.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Fill: Soil materials used to raise existing grades.
- F. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base material.

1.4 SUBMITTALS

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each borrow soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D 698 for each borrow soil material proposed for fill and backfill.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Owner's written permission.
 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: On-site soils are suitable for use as fill within the pavement areas, provided they are free from organics and debris. Select fill must be used for grade adjustments in the helipad area.
- C. Unsatisfactory Soils: Materials, which do not comply with the requirements for acceptable material or which, cannot be compacted to the specified or indicated density.
- D. Subgrade: Stabilize the subgrade to materials as specified by Texas Department of Transportation. The subgrade material should be compacted to at least 98 percent of the modified Proctor maximum dry density (AASHTO T-180).
- E. Base Material: The limerock base course should have a minimum Limerock Bearing Ratio (LBR) of 100 and should be compacted to 98 percent of the modified Proctor maximum dry density (AASHTO T-180).
- F. Select Fill: USCS Classification CL and/or SC, with a Plasticity Index between 10 and 20.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.6 SUBGRADE INSPECTION

- A. Notify Testing Agency when excavations have reached required subgrade.
- B. If Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 1. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL

- A. Place all backfill in strict accordance to Geotechnical Report for this project.
- B. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.

4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- C. Place backfill on subgrades free of mud, frost, snow, or ice.

3.9 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.11 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. All compaction in strict accordance with Geotechnical recommendations.
- B. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment.
- C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
1. Under pavements, scarify and recompact existing subgrade and each layer of backfill or fill soil material at 95 percent. Refer to Geotechnical Report for thickness.
 2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.12 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. (186 sq. m) or less of paved area, as indicated in Geotechnical Report, but in no case fewer than 3 tests.
 - 2. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet (46 m) or less of trench length, but no fewer than 2 tests.
- C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

3.14 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION #31 20 00

SECTION 31 22 15 - FINISH GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Machinery restrictions.
 - 2. Excavation, filling and backfilling of on site material.
 - 3. Subgrade preparation and spreading of topsoil.
 - 4. Finished grading.
 - 5. Prevention of excessive weed growth in lawns.
 - 6. Drainage.
- B. Related Sections
 - 1. Landscape Rough Grade – Section 31 22 14
 - 2. Lawns and Grasses - Section 32 92 00
 - 3. Planting - Section 32 93 00

1.2 GENERAL PROVISIONS

- A. Finished grading shall be defined as placing and grading of additional soil that will be required to bring the grade to the required grades for lawns, shrub and groundcover beds.
- B. Additional fill materials shall generally be defined as topsoil as specified herein unless otherwise specified.
- C. Where practicable and as directed, the use of heavy machinery shall be kept to a minimum.
- D. Refer to Section 32 93 00 for finish grading of shrub and groundcover beds.

1.3 INFORMATIONAL SUBMITTALS

- A. Soil analysis of all on site topsoil to be used for finished grading and planting media prior to stock piling. Soil tests/analysis to be submitted to Landscape Architect along with any planned amendments to meet requirements.

PART 2 - PRODUCTS

2.1 FILL

- A. General Qualifications: Fill shall be a clean, dry soil of a loamy character, well drained and well graded with a plasticity index not to exceed 20 or fall below 8. Fill material shall contain no oils, alkalies, acids, rubbish or other deleterious materials. The pH shall be similar to the approved topsoil.

2.2 TOPSOIL

- A. Topsoil material that will be required for finish grading operations shall conform to the requirements included within this Section and shall come from on site stockpiles.
- B. General Qualifications for Topsoil:
"On-Site" Topsoil shall be considered as material conforming to the following minimum criteria:
 - 1. Natural, friable, loamy soil, typical of local topsoil which produces heavy vegetative growth, free from subsoil, weeds, sods, stiff clay, stones larger than 1", toxic substances, debris, or other substances which may be harmful to plant growth. Do not deliver in muddy condition.
 - 2. Acidity/Alkalinity: pH 6.0 to pH 7.5.
- C. Grading Analysis: 2" sieve, 100% minimum passing. Number 4 sieve, 90% minimum passing. Number 10 sieve, 80% minimum passing.
 - 1. Sand, Silt, and Clay Content (from ASSHTO M146):
 - a. Sand 20 - 45%
 - b. Silt 20 - 40%
 - c. Clay 10 -15%
 - 2. All topsoil shall be free from all herbicides and insecticides which might adversely affect subsequent growth of turf or plantings or which might otherwise contain materials toxic to humans and pets.
- D. Non-Conforming Material: The Contractor shall not be permitted to use on-site material which does not conform to the above minimum criteria for fine grade operations. At the discretion of the Owner's representative, such material can either be amended to meet the minimum requirements or shall be removed from the site and replaced with suitable material as specified herein.
- E. It shall be the Contractor's responsibility to verify that the existing topsoil conforms to these specifications. Topsoil determined to be non-conforming subsequent to the award of a contract shall not be means for extra compensation unless otherwise provided for herein.
- F. Soil Analysis: These samples shall be submitted to an accredited and approved soils laboratory at Contractor's cost. Submit results of soil analysis to the Owner for review. The soil analysis shall include recommendations for amendments to the soil to produce optimum plant growth from the variety of plants and grasses proposed. These amendments shall be made at the Contractor's expense and shall be included in the bid.

2.3 SAND

- A. Shall be Bank Sand. Sample shall be submitted for approval. Sand shall be used for minor finish grade corrections and shall not be permitted for grading purposes if the depth exceeds 1/2" to achieve the finished grade.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Work shall be performed by personnel trained and experienced in this work and shall be done under the direction of a superintendent on Contractor's staff.

3.2 PREPARATION OF SUBGRADE AND SPREADING OF TOPSOIL

- A. The subgrade soil when at optimum soil moisture shall be loosened to a depth of 4" by disking or tilling and then graded to remove all ridges and depressions so that it will be everywhere parallel to the proposed finished grade. All stones over 1 1/2" in any dimensions, sticks, rubbish and other extraneous matter shall be removed during this operation. If soil clumps over 2" in diameter remain, then make additional passes with a harrow or other approved equipment to reduce below the 2" size. No heavy objects except rollers shall be moved over lawn areas after the subgrade soil has been prepared before topsoil is spread.
- B. After the subgrade soil has been prepared, topsoil from the stockpile areas and imported topsoil shall be spread evenly therein to depth of 4" by an approved method. No topsoil shall be spread in a frozen or muddy condition. Areas to receive topsoil are defined as follows:
 - 1. "On-Site Topsoil" – Areas to receive grass (sod, hydroseed, native seeding).
- C. On all grass areas, the finished surface of the topsoil shall conform to the finished grade and shall be free from hollows or other inequalities, stones, sticks and other extraneous matter.
- D. Imported planting soil shall be used to "cap" the repurposed topsoil and eliminate the germination of any dormant seed.

3.3 FINISH GRADING

- A. In areas to receive lawns, this Contractor shall till, disc, or otherwise scarify the soil to a depth of 4" removing all clods, stones, and related material 1" or larger.
- B. This Contractor shall be responsible for minor adjustments to the finished subgrade if such treatment is required in the opinion of the Owner's representative.
- C. The Contractor may use machinery acceptable to the Owner's representative to complete most of the work to re-establishing finished grade.
- D. Hand-rake the surface, removing all clods and undesirable material greater than 1/2" from ground surface. Fill all low spots and cut irregularities to the acceptance of the Owner's representative. Roll the entire surface evenly with a 200 pound water ballast roller or other means acceptable.
- E. During the finished grading operations, all swales and additional swales that may be required to drain areas where there are existing plant materials, shall be finished. In general, all grade adjustments shall be made so there are no areas that will have standing water.
- F. To prevent excessive weed growth in the lawn areas, the Contractor should be prepared to immediately install the sod or seeding upon the completed and acceptable finished grade.
- G. Prior to installation of grass or groundcovers, contact Landscape Architect to inspect and approve finish grade.

END OF SECTION 31 22 15

SECTION 31 23 00 - CONSTRUCTION OF UNDERGROUND UTILITIES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall govern for all excavation required for the construction of sewers, sewer structures, pipe culverts, appurtenances and connections and for the backfilling around completed sewers to the level of the original ground, all in conformity with the locations, lines and grades shown on the plans or as given by the Engineer and in accordance with these specifications. This Section shall also govern for any necessary pumping or bailing and drainage and all sheathing and bracing of trench walls. Also governed by this Section are the cutting and restoration of pavement and base courses, the furnishing and placing of cement stabilized backfill, the hauling and disposing of surplus materials and the bridging of trenches and other provisions for maintenance of traffic or access as provided herein.

1.2 QUALITY ASSURANCE

- A. The Testing Laboratory's representative will determine the moisture density relationship in accordance with ASTM D698 on material secured from the trench excavation. Samples secured from the cement stabilized sand supplier shall be blended with Portland cement in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill, and the moisture density relationship will be determined in accordance with ASTM D558.
- B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Methods D2922 or D1556. The minimum level of testing will consist of at least one test for each 200 linear feet of trench per lift of backfill.
- C. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, all segments shall be video tape recorded and tapes shall be furnished to the owner.

1.3 REQUIRED INSPECTIONS

- A. The contractor is solely responsible for meeting with all inspecting authorities having jurisdiction over the project (to include, but not limited to: Water District, City, County, State and Federal) prior to construction. All required inspections shall be coordinated by the contractor prior to installation of the WORK. All WORK found to be deficient by the inspector(s) and WORK installed prior to notification of inspector(s) shall be removed and replaced at the contractor's sole expense.

PART 2 – PRODUCTS

2.1 CONNECTIONS TO BUILDING GRAVITY SEWERS

- A. Connections to building gravity sewers, to include roof drains and sanitary sewer connections shall be made with SCH 40 X SDR adapter couplings.
- B. Fernco couplers are not allowed.

PART 3 – EXECUTION

3.1 EXCAVATION & TRENCH PREPARATION

- A. Excavate trench to the alignment and depth required. Brace the trench and drain, as required, so that the work may be accomplished safely and efficiently. If necessary, install a dewatering system to provide a dry trench bottom. Pumps shall discharge into natural drainage channels or to drains. Shoring for excavations and trenches shall meet the requirements of the latest edition of OSHA Regulation 1926, Subpart P.
- B. For pipes less than 30 inches in diameter, the minimum width of the trench shall be the width of the outside barrel of the pipe plus 24 inches, the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches. For pipe 30 inches and larger, the minimum trench width shall be the width of the outside barrel of the pipe plus 32 inches, and the maximum width of the trench shall be the width of the outside barrel of the pipe plus 36 inches.
- C. Side sloping or benching of the trench, where permitted, will begin at one foot above the top of the pipe and will not encroach upon private property or endanger existing or future structures or underground utilities. Depth of trench, without sheathing or bracing shall comply with OSHA Regulation 1926.650.
- D. The full width of the trench shall be excavated to a depth below the invert elevation of the pipe so as to permit placing the bedding material specified on the attached drawings below the outside bottom of the pipe. Any additional depth excavated by the Contractor shall be replaced with an equal depth of cement-stabilized sand. The cost of this additional material, in place shall be at the expense of the Contractor.
- E. Where necessary, excavations shall have sheathing and bracing to prevent caving. At these locations, increase the trench width as required and leave the sheathing in place until the pipe has been laid and the backfill compacted to a depth of 2 feet over the pipe. All sheathing and bracing shall be designed to the requirements of OSHA Standard 1926, Subpart P (latest edition).
- F. Sewers shall not be constructed, or sewer pipe laid in the presence of water. All water shall be removed from the excavation sufficiently prior to the sewer placing operation to ensure a dry, firm bed on which to place the sewer and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point system as conditions warrant. There will be no separate pay for well pointing without the prior approval of the Engineer. Contractor shall include in base proposal all costs associated with de-watering, well pointing, stabilizing, etc. necessary to install all underground utilities.
- G. In the event that the excavation cannot be dewatered to the point where the pipe subgrade is free of mud, excessive wet soil, sand silt or clay with water, a seal slab shall be used in the bottom of the excavation. Such seal slab shall consist of a lean concrete mixture. The seal slab shall be a Class "D", 5 sacks of cement per cubic yard with a minimum compressive strength of 1,750 P.S.I. at 7 days and 2,500 P.S.I. at 28 days. A precast seal slab may be used, provided that the joints of the seal slab do not occur at the joint of the pipe. Contractor shall have an option of using a three-day cylinder break test at no expense to the Owner.
- H. For unstable conditions requiring outside forms, seals, sheathing, and bracing, or where groundwater is encountered, any additional excavation in width and backfill required shall be done at the Contractor's expense. Portable trench boxes may be used in lieu of sheathing upon approval in writing by the Engineer. The trench box must be in accordance with OSHA Regulation 1926.650 (latest edition).
- I. Use of the trench box does not relieve the Contractor of any liability for damages to person or property. When a trench box is moved, the jointed pipe or in-place backfill shall not be disturbed.

- J. All materials from excavation operations not required for backfilling, if considered suitable shall be placed in embankments or wasted, in accordance with Section 31 20 00 - Earthwork. All material not suitable for use in embankments will be declared surplus by the Engineer and shall become the responsibility of the Contractor to dispose of as he wishes. Such surplus material shall be promptly removed from the work following the completion of the portion of the sewer involved. No separate payment shall be made for disposal of this surplus material.
- K. Unless otherwise specifically approved, Contractor shall use ladder or wheel-type trench-digging machinery, except where hand methods must be employed to avoid damage to existing structures above or below ground, or where hand excavation is indicated.
- L. Engineer may limit the amount of trench opened or partially opened at any time in advance of the completed pipe laying operation and the amount of trench left unfilled. Open no more than 500 feet of trench at any one time.

3.2 PIPE LAYING

- A. No pipe shall be laid in water or when the trench conditions or weather is unsuitable for such work, unless specifically approved by the Engineer.
- B. Non-pressure concrete pipe shall be laid with the ends abutting and true to line and grade. Fit and lay the pipe to form a smooth and uniform invert. Laying of pipe shall commence at the lowest point, so that the spigot ends point in the direction of flow. Lay cast iron pipe on firm earthen foundation with bell ends facing the direction of laying.
- C. All other types of pipe shall be laid in accordance with the applicable provisions of this specification, in accordance with the Special Provisions preceding this Subsection, or with the manufacturer's recommendations.
- D. Cut cast iron pipe with wheel-type cutters or cold chisel. Flame cutting of cast iron pipe is not allowed. Make cuts in a neat and workmanlike manner without damage to pipe and so as to leave a smooth end at right angles to axis of pipe. Field cutting of Polyvinyl Chloride shall be in accordance with the pipe manufacturer's recommendations.
- E. Minor deflections may be obtained in pipe joints. Contractor must obtain approval when the degree of deflection is necessary to deflect from a straight line. Where necessary to make major deflections in concrete pipe, use sections of pipe with beveled ends for deflections not greater than five degrees. For deflections greater than five degrees, use fabricated fittings for concrete pressure pipe and use cast iron fittings for cast iron pipe.
- F. When the pipe laying operation is halted, seal the open end of the pipe with a temporary plug. Plug is to remain in place until the pipe laying operation re-commences. Standard plugs shall be inserted into bells of all dead-end pipe.
- G. All underground pipe shall have a 12-gauge metallic tracer wire running the full length of the pipe. Tracer wire shall be taped to the pipe at intervals not to exceed 15-feet using duct tape and terminate at each end above ground in a 2" PVC riser.
- H. Pipe shall be installed with the labels facing upward.
- I. At the completion of the project, all on site storm and sanitary sewer lines shall be cleaned out using a hydraulic jet machine in the presence of the owner and engineer. After hydro-jetting storm and sanitary sewer lines, contractor shall run video-camera through pipes and video-record each line segment in order to document proper installation.

3.3 BACKFILLING

- A. As soon as practicable after completion of laying and jointing of pipe, backfill the trench. Not more than 200 feet of the trench shall be left open after laying the pipe.
- B. Trenches shall be backfilled in accordance with drawing details and notes. Backfill material selected from sewer trench excavation, or obtained from other sources, shall be free from stones, which will interfere with compaction and free of large lumps, which will not break down readily under compaction. Do not use material excavated in large lumps which will not break down or which cannot be spread in loose layers. Material excavated by trenching machine will generally be suitable for use as backfill. Cement stabilized sand shall be in accordance with Section 31 23 23.16 - Cement Stabilized Sand Bedding and Backfill.
- C. When placing backfill in the trench simultaneously on both sides of the pipe for the full width of the trench, moisten if necessary and tamp in approximately 6-inch layers, thoroughly compacting under and on each side of the pipe to provide solid backing against the external surface of the pipe. Walking or working on the completed pipeline, except as necessary in tamping or backfilling shall not be permitted until the trench has been backfilled to at least 12-inches over the top of the pipe.

3.4 RESTORATION OF SURFACES

- A. Replace or repair sidewalks, driveway culverts, inlets, curbing, gutters, shrubbery, trees, fences, sod and other like obstructions removed or disturbed, to the condition equivalent to that existing prior to commencement of this work. Use concrete having a compressive strength of not less than 3,000 psi in 28 days for the replacement of curbing, gutters, inlets and sidewalks.
- B. Use reasonable care in the removal and replacement of shrubbery and trees designated to be replaced at original locations. Where at all possible, ditch alignment will be such as to minimize this work. The restoration of asphalt-topped flexible base and concrete streets shall be as specified under other items of the specifications.

3.5 CLEAN-UP

- A. The Contractor shall remove from the site of the work and from public and private property temporary structures, rubbish, and waste materials, including excess excavated materials. The Contractor is responsible for disposing of all surplus earth. The pipe laying operation shall be temporarily suspended if the clean-up is falling behind as determined by the Engineer or Owner.

3.6 MEASUREMENT & PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 00

SECTION 31 23 16.16 - STRUCTURAL EXCAVATION AND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SCOPE

- A. This section describes the excavation for all structures except pipe sewers, the backfilling around completed structures and the disposal of all excess excavated material. All operations required for the proper completion of the excavation work, including sheeting, shoring and bracing, dewatering of excavations and compaction of backfill are included under this section.

1.2 PROTECTION

- A. Before the start of earthwork operations, adequately protect existing structures, utilities, trees and shrubs and other permanent objects. Costs resulting from damage to permanent facilities due to negligence or lack of adequate protection will be charged to the Contractor. The Contractor will also be charged for damage to facilities scheduled for later removal or demolition if the damage sufficiently impairs proper operation to the extent that temporary replacement or repair is required.

1.3 PAYMENT

- A. No separate payment will be made for work performed under this section. Include the cost of such work in the bid form and specified in other sections of this work.

1.4 BLASTING

- A. Blasting will not be permitted.

PART 2 - PRODUCTS

2.1 REGULAR BACKFILL

- A. Where no other backfill is specified, use suitable soils from the excavation as backfill material.

2.2 SAND BACKFILL

- A. Where sand backfill is specified, use reasonably clean bank sand from an approved source. The sand must be free from large lumps of clay, rubbish, organic matter or other deleterious substances. Not more than 12 percent by weight shall pass the 200-mesh sieve and the plasticity index shall not exceed 4.0. This backfill shall be placed a minimum of 18 inches wide around all below-grade structures.

2.3 FILTER MATERIAL BACKFILL

- A. Where shown, use a mixture of concrete gravel and concrete sand. Proportion the mixture with two parts gravel to one-part sand by volume. Gravel and sand shall meet requirements of ASTM C 33. The maximum size of acceptable gravel is 1-1/2 inches.

2.4 CEMENT STABILIZED BACKFILL

- A. Prepare a mixture of sand, cement and water.

- B. Use washed river sand free from large clay lumps or unacceptable amounts of other foreign materials. The sand must not be darker than the standard color when subjected to a color test in accordance with ASTM C 40.
- C. Required gradation of sand:
- | Screen Size | Percent Retained |
|-----------------|--------------------------|
| 3/8-inch screen | 0 percent |
| 1/4-inch screen | 0 percent - 5 percent |
| 20 mesh screen | 15 percent - 50 percent |
| 100 mesh screen | 80 percent - 100 percent |
- D. Use Type I cement conforming to ASTM C 150.
- E. Mix in a pug mill using not less than 1-1/2 sacks of cement per cubic yard (unless otherwise specified) of mixture with sufficient water to hydrate the cement.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavation work shall be unclassified and includes removal of all types of materials encountered without exception. Make excavations to lines and grades indicated on drawings. Complete excavations within the tolerances specified. Perform all work in conformity with the rules and regulations of the Federal Occupational Safety and Health Act.
1. **Shoring, Bracing, Dewatering:** Provide shoring, bracing and dewatering of excavations required to properly and safely complete the work as shown. Construct shoring and bracing to prevent the excavation from extending beyond specified or indicated limits and to protect workmen. Keep excavations dewatered by drainage, pumps or well points as necessary while work is in progress. Dewatering methods are subject to approval. Remove shoring, bracing and sheathing as excavations are backfilled in a manner to prevent injurious caving.
 2. **Pipe Trenches:** Excavate by open cut methods. Make and maintain the sides of the trench as nearly vertical as practical. Provide shoring to maintain the sides of the trench in a vertical position and to protect workmen. Complete and shape the trench to provide free working space and to permit thorough tamping of backfill around the pipe. Grade trench bottoms accurately to provide uniform bearing on firm soil along the entire length of each pipe section. Remove rubbish, rock or debris encountered at grade to at least 6 inches below the bottom of the pipe. Reshape and compact the trench bottom. Working space measured from the outside of the pipe to the side of the trench must be at least 6 inches but not more than 24 inches. Provide bell holes where required for making proper connections at joints.
- B. Structures Other than Pipes:
1. Wherever practicable cut all footing excavations to neat lines with a tolerance of minus 1 inch or plus 3 inches and place concrete to bear against earth sides. Cut all excavations a sufficient distance from walls, shafts or similar elements of structures to allow for placing and removing forms and for inspection. Make all excavations at a minimum slope of 1:1 with 3 feet cut outside of footing lines or wall lines except as shown or specifically authorized.
 2. Carry all excavations to the elevations shown and to deeper levels as directed when suitable foundation soils are not encountered at plan depth. Remove all pockets of soft or otherwise unstable soils and replace with concrete or with suitable well compacted soil as directed.
 3. Fill all unauthorized excessive excavation with concrete at no change in the contract sum.

4. Protect all open excavations from rainfall or excessive drying. Provide pumps and other equipment as required to keep excavations reasonably free of water at all times and completely free of water during placement of concrete.
5. Do not remove the last 4-inch depth of excavation for slabs or footing until reinforcing steel and concrete are ready to be placed.
6. For footings founded on rock, hard shale or similar material, remove all loose material. Clean and cut to a firm surface either level, stepped or serrated as directed. Clean out seams and fill with concrete at the time footing concrete is placed.

3.2 BACKFILL

- A. Complete backfill to the surface of natural ground or to the lines and grade shown on drawings. Except where special materials are requested, use suitable soils from the excavation as backfill material. Do not use peat or other organic matter, silt, muck, debris or similar materials. Deposit backfill in uniform layers and compact each layer as specified.
 1. Backfill at Structures: Place backfill as promptly as practicable after completion of each structure or portion of a structure. Do not, however, place backfill against concrete walls or similar structures until concrete has been cured at least seven days. Remove concrete forms before starting to backfill and remove shoring and bracing as the work progresses. Take care to prevent any wedging action of backfill against the structure. Step cut or serrate the slopes bounding the excavation as required to prevent wedging.
 2. Backfilling of Pipe Trenches:
 - a. Refer to appropriate paragraphs of SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES.
 3. Compaction of Backfill:
 - a. Refer to appropriate paragraphs of SECTION 31 23 00 – CONSTRUCTION OF UNDERGROUND UTILITIES.

3.3 DISPOSAL OF EXCESS MATERIAL

- A. Dispose of excess or unsuitable material from the excavation off the job site.

END OF SECTION 31 23 16.16

SECTION 31 23 23.13 - BANK SAND BACKFILL

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section shall consist of the furnishing, placing, manipulation, compacting and completing in-place, Bank Sand as a bedding and backfill material for water and sewer lines, as construction fill for certain excavation areas, as construction fill for ruts, holes and other similar conditions; as a fill material for project clean-up and as directed by the Engineer. Bank sand shall be in accordance with these specifications and in conformity with the lines, grades and cross-sections shown on the plans and as directed by the Engineer.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Bank sand is to be free of organic matter, foreign material, clay balls, sticks, foreign objects and other objectionable material. Bank sand shall have a plasticity index less than three (3) and shall meet the following gradation: 100 percent passing a 3/8-inch sieve, 5 to 30 percent passing a No. 200 sieve. Prior to use, Contractor shall identify the source of the proposed bank sand for testing.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. After the water line, sewer line or other similar construction item, such as a trench, has been excavated and brought to grade, bank sand shall be furnished, placed, compacted complete in-place, either as bedding or backfill material, as shown on the plans, described in these specifications or as directed by the Engineer. After the trench or excavation has been brought to grade, the bank sand shall be placed and compacted as a bedding material, the construction item shall be placed and joined properly around and over that construction item as required and as shown on the plans, described in the specifications or directed by the Engineer. Bank sand shall be placed in layers not exceeding 8-inches. It shall be compacted with mechanical vibratory tamps to maximum dry density in accordance with ASTM Method D698 at a moisture content ranging from optimum to three percentage points above optimum. Water flooding will not be permitted.

3.2 TESTING

- A. The Testing Laboratory's representative will determine the moisture density relationship for each material proposed for use as backfill, in accordance with ASTM Method D698. In place density will be determined in accordance with ASTM Methods D2922 or D1556, and with each type of construction. For walls and trenches, determine the in-place density for each 200 feet of wall or trench, for each lift of fill placed.

3.3 MEASUREMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

END OF SECTION 31 23 23.13

SECTION 31 31 16 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Furnishing and applying both pre-construction and post-construction subterranean termite control treatment as described herein on the Project.

1.3 COORDINATION

- A. Each offeror shall be responsible for determining during the proposal period the extent that any addenda issued during the proposal period may affect this Section of the Specifications.
- B. Reference instructions to offerors for requirements regarding substitutions of materials and products.
- C. Where conflicts occur between the Drawings and Specifications, between different drawings, between portions of this Section of the Specifications, or between different sections of the specifications, the more stringent requirements and the greater quantity shall apply.
- D. Contractor shall notify Structural Pest Control Board (SPCB) prior to application of termite treatment at the site as required by law.
- E. Comply with all federal, state, and local requirements and authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Applicator shall be bonded and licensed with all applicable authorities.
- B. Products and application techniques shall meet all requirements of federal, state, and local regulations regardless of products and techniques specified herein.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's printed literature describing products and detailed application requirements.
 - a. Document that product is currently allowed by the Environmental Protection Agency (EPA), the State of Texas, and all applicable county and local authorities for use under building slabs.
 - 2. Material Safety Data Sheet (MSDS).
- B. Samples:
 - a. Of proposed written warranty.
- C. Certification:
 - 1. After the completion of Work under this Section, submit as part of the Close Out Documents, manufacturer's affidavit from the the Pest control Company stating that "The building has received a complete treatment for the prevention of subterranean termites, and that treatment is in accordance with rules and laws established by the Florida Department of Agriculture and Consumer Services."
 - 2. After completion of Work under this Section, submit manufacturer's signed affidavit, verifying specification compliance of the chemicals, their proportions, and application.
 - 3. Contractor shall certify that pesticide used on project does not contain the chemical or have any ingredient known as "Dursban".

1.6 WARRANTY

- A. Provide written warranty against defects in materials and application for a period of five (5) years after application.
- B. Defects shall include, but not be limited to the following:
 - 1. Evidence of activity by subterranean type termites.
 - 2. Damage of building materials due to subterranean termites.
- C. During the warranty period the applicator shall, at his own expense provide additional termite treatment as required to prevent termite activity. Repair or replace building materials damaged by subterranean termite activity during the warranty period at no expense to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Termidor 80 WG Termiticide/Insecticide (EPA Reg. No. 7969-209) as manufactured by BASF Corporation, Florham Park, NJ; (973) 245-6000 or comparable product approved by Architect with minimum five (5) years of experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions in order to be considered.

2.2 MATERIALS

- A. Dry powder containing 80% active ingredient and is conveniently package in water-soluble packages (paks).
- B. Finished dilution: 0.125%.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect building earth fill and foundation excavation for readiness and to ensure that soils are not too wet for proper application of treatment.
- B. Post conspicuous warning signs indicating date(s) and time(s) of application and notify contractors working in area of such date(s) and time(s).

3.2 MIXING

- A. Mixing shall be in accordance with manufacturer's printed instructions.

3.3 APPLICATION

- A. Do not apply while school is in session.
- B. Apply to ensure a continuous chemical barrier.
- C. Pre-Construction Treatment:
 - 1. Apply an overall treatment to the entire surface of soil or other substrate to be covered by the slab, including areas to be under carports, porches, basement floor, and entrance platforms in accordance with manufacturer's printed instructions and recommended application rates.
 - 2. Apply along inside of foundation walls, and around plumbing, bath traps, utility services, and other features that penetrate the slab in accordance with manufacturer's printed instructions and recommended application rates.
 - 3. Apply at crawl spaces, at hollow block foundations or voids in masonry resting on the footing, and at plenums in accordance with manufacturer's printed instructions and recommended application rates.
- D. Post-Construction Treatment:
 - 1. Apply a treatment under the slab, including attached porches, carports, entrance platforms, garages and similar slab structures in accordance with manufacturer's printed instructions and recommended application rates. Drill all holes spaced in a manner to

allow for application of a continuous chemical barrier. Plug and fill all drill holes in occupied areas or where visually exposed with a suitable sealant recommended by manufacturer.

2. Apply at existing cracks and cold, construction and expansion joints and around bath traps, plumbing and utility services which penetrate the slab in accordance with manufacturer's printed instructions and recommended application rates.
3. Apply at crawl spaces in accordance with manufacturer's printed instructions and recommended application rates.
4. At perimeter grade beams, trench along beams or use rodding as recommended by the manufacturer. The final treatment of the exterior beam will be performed within 30 days of notification of completion of landscaping or one (1) year from the date of completion of construction.
5. Allow for drying after application, in accordance with manufacturer's instructions, before placing vapor barrier and beginning concrete placement or other construction activities.
6. All treatment applications must be in compliance with all federal, state, and local laws and regulations with regard to mixing, applying, and disposing of debris and waste.

END OF SECTION 31 31 16

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SECTION 31 32 13.19 - LIME STABILIZED SUBGRADE

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This item shall consist of treating the subgrade, by the pulverizing, addition of lime, mixing and compacting the mixed material to the required depth and density, and in the amounts shown on the plans.
- B. This item applies to natural ground, embankment, base or sub-base and shall be constructed to the sections, lines and grades shown on the plans. The subgrade shall be stabilized with lime to a depth of at least 6-inches in the amount recommended by a materials engineering laboratory. The P.I. shall be determined by ASTM Method D4318.

1.2 QUALITY ASSURANCE

- A. The Testing Laboratory's representative will determine the Moisture-Density Relationships in accordance with ASTM Method D698 on material secured from the roadway after stabilization with lime, for each type of material encountered.
- B. The Testing Laboratory's representative will determine the in-place density in accordance with ASTM Method D2922 or D1556. The minimum level of testing will consist of at least three tests for each 1,000 feet per lane of roadway or 4,000 square feet (500 square yards) of embankment.

1.3 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Lime for stabilization shall be classified as Type A- Hydrated Lime, or Type B- Commercial Lime Slurry, conforming to the requirements of Section 31 32 13.20 - Hydrated Lime and Lime Slurry.

2.2 EQUIPMENT

- A. The machinery, tools and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to the beginning of construction operations. All machinery, tools and equipment used shall be maintained in a satisfactory and workmanlike manner.

PART 3 – EXECUTION

3.1 CONSTRUCTION METHODS

- A. It is the primary requirement of this specification to secure a completed course of treated material containing a uniform lime soil mixture free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing

subsequent courses. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

- B. The subgrade shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer. The subgrade shall be firm and able to support, without displacement, the construction equipment at the density herein specified. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime, and compacting, or other methods until satisfactory stability is obtained. The cost of the repair of the secondary subgrade and any materials below the secondary subgrade is incidental to this Section.
- C. The Contractor shall be required to proof-roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal.
- D. Lime shall be spread only on that area where the first mixing operations can be completed during the same working day. The application and mixing of lime with the material shall be accomplished by the methods hereinafter described as "Dry Placing" or "Slurry Placing". When Type A, Hydrated Lime, is specified, the Contractor may use either method, unless otherwise noted on the plans.
- E. When dry placing, the lime shall be spread by an approved spreader or by bag distribution at the rates shown on the Bid Sheet, or as directed by the Engineer.
- F. The lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime.
- G. The material shall be sprinkled as directed by the Engineer, until the proper moisture content has been secured. Where Type A, hydrated lime is specified and slurry placement is used, the Type A hydrate shall be mixed with water to form a slurry of the solids content designated by the Engineer. A minimum of two mixing passes will be required.
- H. Where Type B, commercial lime slurry is to be used, it shall be of the minimum solids and purity for the applicable grade being used. The distribution of lime shall be at the rates shown on the proposal form, or as directed by the Engineer. Proper application shall be attained by successive passes over a measured section of the roadway, until the proper moisture and lime content has been secured. The distributor truck shall be equipped with an agitator, which will keep the lime and water in a uniform mixture.
- I. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until, in the opinion of the Engineer, a homogenous friable mixture of material and lime is obtained, such that when all non-slaking aggregates retained on the 3/4-inch sieve are removed, the remainder of the material shall meet the following requirements when tested in accordance with ASTM Method C136, from samples procured from the roadway.

TABLE I

Minimum Passing 1 3/4" sieve	100 Percent
Minimum Passing 3/4" sieve	85 Percent

- J. If gradation is achieved on the first mixing, no additional mixing is required.
- K. The soil lime mixture shall be sprinkled during the mixing operation as directed by the Engineer to provide optimum moisture in the mixing. The subgrade shall be stabilized to a minimum depth of 6-inches and compacted to a minimum of 95-percent of standard proctor density (ASTM D698) at a moisture content of optimum to 3-percent above optimum.

LIME STABILIZED SUBGRADE

- L. During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6-hours, or more, or has had excessive loss due to washing or blowing will not be accepted for payment.
- M. Compaction of the mixture shall begin immediately after final mixing unless approval has been obtained from the Engineer not to do so. The material shall be aerated and/or sprinkled as necessary, to provide the optimum moisture content. Compaction shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted.
- N. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment and the mixing continued until, in the opinion of the Engineer, a homogenous, friable mixture of material and lime is obtained, free from all clods or lumps. Materials containing plastic clays or other materials which will not readily mix with lime shall be mixed as thoroughly as possible at the time of lime application, brought up to the proper moisture content and left to cure 48 to 96, hours as directed by the Engineer. During the curing period the material shall be kept moist as directed.
- O. If a second mixing is required, the material shall be given a final mixing, using approved methods. If the soil binder-lime mixture contains clods, they shall be reduced in size by raking, blading, discing, harrowing, scarifying, or the use of other approved pulverization methods, so that all non-slaking material retained on the 3/4-inch sieve is removed and the remainder of the material shall meet the gradation requirements outlined by Table I. After the second mixing has been completed, the material shall be allowed to cure for a minimum of 3 days, unless otherwise directed by the Engineer.
- P. The material shall be sprinkled and rolled, as directed by the Engineer. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and re-compacting by sprinkling and rolling. The surface of the course shall be maintained and cured for a minimum of 3 days, prior to placing a base or surface course or until traffic is allowed to travel thereon.
- Q. In addition to the requirements specified for density, the full depth of the material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests as necessary will be made by the Engineer. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. Throughout this entire operation, the shape of the course shall be maintained by blading and the surface upon completion shall be smooth and in conformity with the typical section shown on the plans and to the established lines and grades. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed or the work is accepted, it shall be reprocessed and refinished at the expense of the Contractor.

3.2 FINISHING

- A. After the final course of the lime treated subgrade has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed section shall then be finished by rolling as directed with a pneumatic tire or other suitable roller sufficiently light to prevent hair cracking. The completed section shall be moist, or emulsion cured until covered by base material, unless otherwise directed by the Engineer. If the plans provide for the treated material to be sealed or covered by other courses of material, such seal or course shall be applied within 14 days after final mixing and compaction is completed, unless otherwise directed by the Engineer.

END OF SECTION 31 32 13.19

SECTION #31 32 13 – SOIL MIXING STABILIZATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 - General Requirements shall govern the work under this section.
- B. This Section includes soil mixing stabilization and specialties outside the building, including the following:
 - 1. Excavation, treatment, and backfilling of subgrade for lime stabilization.
- C. All soil mixing stabilization to be performed and materials used shall be in accordance with the Geotechnical Engineering Report. In the event of a discrepancy between the above-referenced report and any portion of this specification section, the above-referenced report will govern. The Contractor shall contact the Engineer in the event of a discrepancy.

1.2 REFERENCE STANDARDS

- A. American Society for Testing Materials (ASTM) latest edition
 - 1. C150 Portland Cement
 - 2. C618 Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
 - 3. C 977 Quicklime and Hydrated Lime for Soil Stabilization
 - 4. D 1633 Compressive Strength of Molded Soil-Cement Cylinders
- B. American Association of State Highway and Transportation Officials (AASHTO) latest edition
 - 1. M 216 Lime for Soil Stabilization
- C. National Lime Association (NLA)
 - 1. Bulletin 326 Lime Stabilization Construction Manual
- D. Texas Department of Transportation Standards
 - 1. TXDOT Item 260 Lime Treatment (Road Mixed)
 - 2. TXDOT Item 265 Fly Ash or Lime – Fly Ash Treatment (Road Mixed)

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Do not install mixed materials in wind in excess of 10 mph or when temperature is below 40 degrees Fahrenheit.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with state and local standards in conjunction with requirements specified herein.

1.5 SUBMITTALS

- A. Submit 30-pound sample of each material to be used at the site in airtight containers to the independent testing laboratory or submit gradation and certification of material that is to be used to the independent testing laboratory for review.
- B. Submit name of each materials supplier and specific type and source of each material. Change in source requires approval of Owner.
- C. Submit mix design and materials mix ratio that will achieve specified requirements of state and local agencies for soil stabilization.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Hydrated Lime: TXDOT Item 260

2.2 EQUIPMENT

- A. Perform operations using suitable, well maintained equipment capable of excavating subsoil, mixing and placing materials, wetting, consolidating, and compacting of material.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Obtain approval from the independent testing laboratory of mix design before proceeding with placement.
- B. Start stabilization only when weather and soil conditions are favorable for successful application of proposed material.
- C. Proofroll subgrade to identify areas in need of stabilization in accordance with Section 312000.

3.2 EXCAVATION

- A. Excavate subsoil to depth sufficient to accommodate soil stabilization.
- B. Remove lumped subsoil, boulders, and rock that interfere with achieving uniform subsoil conditions.
- C. Notify Construction Manager of unexpected subsurface conditions. Discontinue affected work in area until notified to resume work.
- D. Correct areas over-excavated in accordance with Section 31 20 00.
- E. Remove excess excavated material from site.

3.3 SOIL TREATMENT AND BACKFILLING

- A. Lime Stabilized Subgrade: Where indicated on Construction Drawings or as required after continual failure, treat prepared subgrade with hydrated lime in accordance with state highway department specifications (TXDOT Item 260).
 - 1. A minimum of 48 hours of tempering time shall be provided before final mixing.
 - 2. Subgrade soils shall be treated with lime at a rate of 6 to 8 percent lime, by dry weight.
- B. Subsoil shall be in accordance with Section 31 20 00.
- C. Maintain optimum moisture of mixed materials to attain required stabilization and compaction.
- D. Finish subgrade surface in accordance with Section 31 20 00.
- E. Remove surplus mix materials from site at no additional cost to the Owner.

3.4 CURING

- A. Immediately following compaction of mix, seal top surface with curing seal.
- B. Do not permit traffic for 72 hours after sealing top surface.

3.5 FIELD QUALITY CONTROL

- A. Compression test and analysis of hardened fill material will be performed in accordance with Section 02300.
- B. If tests indicate work does not meet specified requirements, remove work, replace and retest, at no cost to owner.

END OF SECTION #31 32 13

SECTION 31 41 00 - TRENCH SAFETY SYSTEM

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 SUMMARY

- A. This item is for furnishing all labor and materials for installation and maintenance of a trench safety system.
- B. For any trench excavation in materials other than solid rock, greater than five (5) feet in depth, or where shown on the plans, the contractor shall provide a trench safety system. This trench safety system shall be in accordance with the appropriate requirements established in the Occupational Safety and Health Administration (OSHA), Safety and Health Regulations, Part 1926, Subpart P - "Excavations, Trenching and Shoring" (latest edition).

1.2 MEASUREMENT

- A. Measurement of the "Trench Safety System" for gravity pipelines and boxes and for pressure pipelines shall be made by the linear foot of trench measured along the centerline of the trench.

1.3 PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION 31 41 00

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - 1. Section 013200 "Construction Progress Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 015000 "Temporary Facilities and Controls" for temporary utilities and support facilities.
 - 3. Section 312000 "Earth Moving"
 - 4. Section 312319 "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Shop Drawings: For excavation support and protection system.
- B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Other Informational Submittals:
 - 1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.
 - 2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify all impacted parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2. The geotechnical report is referenced elsewhere in the Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Delete this article if Contractor selects temporary excavation support and protection. Revise materials if prescribing excavation support and protection system requirements.
- B. General: Provide materials that are either new or in serviceable condition.
- C. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- D. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Corners: Site-fabricated mechanical interlock or roll-formed corner shape with continuous interlock.
- E. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.

2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION #31 50 00 – EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 312000 "Earth Moving" for excavating and backfilling and for controlling surface-water runoff and ponding.
 - 3. Section 312319 "Dewatering" for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review geotechnical report.
 - 2. Review existing utilities and subsurface conditions.
 - 3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
 - 4. Review proposed excavations.
 - 5. Review proposed equipment.
 - 6. Review monitoring of excavation support and protection system.
 - 7. Review coordination with waterproofing.
 - 8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
 - 1. Include plans, elevations, sections, and details.
 - 2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
 - 3. Indicate type and location of waterproofing.
 - 4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.
- C. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
 - 1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Corners: [Site-fabricated mechanical interlock] [Roll-formed corner shape with continuous interlock].
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
- E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.

3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks as required during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.7 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
 3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION #31 50 00

SECTION 31 63 29 - DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Dry-installed drilled piers.

1.3 UNIT PRICES

- A. Unit prices are included in Section 01 22 00 "Unit Prices."
- B. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, and bell diameter if applicable, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments will be made on net variation of total quantities, based on design dimensions for shafts and bells.
 - 1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft, extended through the bell, if applicable, and the diameter of shaft and bell.
 - 2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.
- C. Trial Drilled Pier: Unit price as indicated for drilled pier, including backfilling.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.
- D. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
- F. Field quality-control reports.

- G. Other Informational Submittals:
 - 1. Record drawings.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.
- B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.
- C. Drilled-Pier Standard: Comply with ACI 336.1 unless modified in this Section.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.
 - 1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.
- B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Notify all affected parties including Owner no fewer than five (5) days in advance of proposed interruption of utility.
 - 2. Do not proceed with interruption of utility without Owner's written permission.
- C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
 - 2. The geotechnical report is referenced elsewhere in the Project Manual.
- D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
 - 1. Record and maintain information pertinent to each drilled pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Refer Section 03 20 00.

2.2 CONCRETE MATERIALS

- A. Refer Section 03 30 00 and Structural General Notes.

2.3 STEEL CASINGS

- A. Steel Pipe Casings: ASTM A 283, Grade C, or ASTM A 36, carbon-steel plate, with joints full-penetration welded according to AWS D1.1.
- B. Corrugated-Steel Pipe Casings: ASTM A 929, steel sheet, zinc coated.

2.4 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.
- C. Proportion normal-weight concrete mixture as follows:
 - 1. As indicated in Structural General Notes.

2.5 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

- A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
 - 1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time will be authorized for removal of obstructions.
 - 2. Obstructions: Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work will be according to Contract provisions for changes in the Work.
- B. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

- C. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.
 - 1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
 - 2. Remove water from excavated shafts before concreting.
- D. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.
 - 1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
 - 2. Payment for additional authorized excavation will be according to Contract provisions for changes in the Work.
- E. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.
- F. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.
 - 1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.
- G. Bells: Excavate bells for drilled piers to shape, base thickness, and slope angle indicated. Excavate bottom of bells to level plane and remove loose material before placing concrete.
- H. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.
 - 1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

3.3 STEEL REINFORCEMENT

- A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
- C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.
- D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.
- E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.
- F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.4 CONCRETE PLACEMENT

- A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by Owner's independent testing and inspecting agency.
 - 1. Construct a construction joint if concrete placement is delayed more than one hour. Level top surface of concrete. Before placing remainder of concrete, clean surface laitance, roughen, and slush concrete with commercial bonding agent or with sand-cement grout mixed at ratio of 1:1.
- B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.

1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
 2. Vibrate top 60 inches of concrete.
- C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.
1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.
- D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.
- E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.
1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.
- F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Drilled piers.
 2. Excavation.
 3. Concrete.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.
1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities will be determined by testing and inspecting agency. Final evaluations and approval of data will be determined by Architect.
- D. Concrete Tests and Inspections: ASTM C 172 except modified for slump to comply with ASTM C 94.
1. Slump: ASTM C 143; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
 2. Concrete Temperature: ASTM C 1064; 1 test hourly when air temperature is 40 deg F and below and 80 deg F and above, and 1 test for each set of compressive-strength specimens.
 3. Compression Test Specimens: ASTM C 31; one set of four standard 6-inch x 12-inch cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.

4. Compressive-Strength Tests: ASTM C 39; one set for each drilled pier but not more than one set for each truck load. One specimen will be tested at 7 days, 2 specimens will be tested at 28 days, and 1 specimen will be retained in reserve for later testing if required.
 5. If frequency of testing will provide fewer than five strength tests for a given class of concrete, testing will be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 6. If strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests: Testing and inspecting agency will make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.
 - a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.
 11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports for each drilled pier as follows:
1. Actual top and bottom elevations.
 2. Actual drilled-pier diameter at top, bottom, and bell.
 3. Top of rock elevation.
 4. Description of soil materials.
 5. Description, location, and dimensions of obstructions.
 6. Final top centerline location and deviations from requirements.
 7. Variation of shaft from plumb.
 8. Shaft excavating method.
 9. Design and tested bearing capacity of bottom.
 10. Levelness of bottom and adequacy of cleanout.
 11. Ground-water conditions and water-infiltration rate, depth, and pumping.
 12. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
 13. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
 14. Bell dimensions and variations from original design.
 15. Date and time of starting and completing excavation.

16. Inspection report.
17. Condition of reinforcing steel and splices.
18. Position of reinforcing steel.
19. Concrete placing method, including elevation of consolidation and delays.
20. Elevation of concrete during removal of casings.
21. Locations of construction joints.
22. Concrete volume.
23. Concrete testing results.
24. Remarks, unusual conditions encountered, and deviations from requirements.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 63 29

SECTION #32 13 13 - CONCRETE PAVING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 – General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

- A. This Section includes exterior cement concrete pavement for driveways, parking lots, curbs and gutters, and walkways.
- B. All concrete paving to be performed and materials to be used shall be in accordance with the Geotechnical Engineering Report and the applicable requirements in the American Concrete Institute's Manual of Concrete Practice. In the event of a discrepancy between the above-referenced report and any portion of this specification section, the above-referenced report will govern. The Contractor shall contact the Engineer in the event of a discrepancy.

1.3 SUBMITTALS

- A. Mix Design: Submit one (1) copy of the Mix design prepared by the batch plant servicing the Project.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1.5 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 – PRODUCTS

2.1 FORMS

- A. Form Materials: construction grade wood or metal, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60.
- B. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- C. Tie Bars: ASTM A 615/A 615M, Grade 60.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Portland Cement: ASTM C 150, Type II

- B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size 3/4 inch (19 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber

2.6 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 45 minutes.

2.7 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 10 inches wide by 72 inches long. Provide chamfered corners and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel, 3/4-inch (19-mm) diameter, 18-inch (254-mm) minimum length.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 2. Compressive Strength (28 Days): 3,500 psi
 - 3. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50
 - 4. Slump Limit: 4 inches
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: do not exceed 2 percent
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a 20-ton pneumatic roller or similar equipment, such as a fully loaded dump truck.
 - 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."
Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 2. Provide tie bars at sides of pavement strips where indicated.
 - 3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Extend joint fillers full width and depth of joint.
 - 2. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.

3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement:
 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch (10-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
- F. Joint sealants: Joints shall be sealed with approved exterior pavement joint sealants and shall be installed in accordance with manufacturer's recommendations.

3.6 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.
 2. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

- a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
- D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION #32 13 13

SECTION #32 13 14 – CONCRETE SIDEWALK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 – General Requirements shall govern the work under this Section.

1.2 WORK INCLUDED

- A. The work specified in this Section consists of the construction of concrete sidewalk in accordance with these Specifications and in conformity with the lines, grades, dimensions and notes shown on the plans.

1.3 RELATED WORK

- A. Section 024119 – Selective Demolition
- B. Division 31 – Earthwork

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Concrete shall be Class A Concrete unless otherwise shown on the plans.

2.2 FORMS

- A. Forms for this work shall be made of either wood or metal and shall have a depth equal to the plan dimensions for the depth of concrete being deposited against them. They shall be straight, free from warp or bends, and of sufficient strength when staked, to resist the lateral pressure of the concrete without displacement from lines and grade. Forms shall be cleaned each time they are used and shall be oiled prior to placing the concrete.

2.3 SUBGRADE AND GRADING

- A. Excavation shall be made to the required depth, and the foundation material upon which the sidewalk is to be set shall be compacted to a firm, even surface, true to grade and cross-section, and shall be moist at the time that the concrete is placed.

2.4 JOINTS

- A. Expansion joints between the sidewalk and the curb, and at all other locations indicated on the plans, shall be 1/4-inch wide, formed with a preformed joint filler. Preformed joint filler shall meet the requirements of AASHTO M153 or AASHTO M213.
- B. Contraction joints may be of the open type or may be sawed. Open type contraction joints shall be formed by staking a metal bulkhead in place and depositing the concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint, the bulkhead shall be removed. After the sidewalk has been finished over the joint, the slot shall be edged with a tool having a 1/2-inch radius.

If the CONTRACTOR elects to saw the contraction joints, a slot approximately 1/8-inch-wide and not less than 1-1/2 inches deep shall be cut with a concrete saw after the concrete has set, and within the following periods of time:

Contraction joints shall be constructed at not more than twenty (20) foot intervals, and shall be in place within twelve (12) hours after finishing.

PART 3 - EXECUTION

3.1 PLACING

- A. The concrete shall be placed in the forms to the required depth and shall be vibrated and spaded until mortar entirely covers its surface.

3.2 FINISHING

- A. Screeding: The concrete shall be struck-off by means of a wood or metal screed, used perpendicular to the forms, and floated in order to obtain the required grade and remove surplus water and laitance.
- B. Surface requirements: The concrete shall be given a broom finish. The surface variations shall not be more than 1/4 inch under a ten-foot straightedge, nor more than 1/8 inch on a five-foot transverse section. The exposed edge of the slab shall be carefully finished with an edging tool having a radius of 1-1/2 inch.

3.3 CURING

- A. The concrete shall be continuously cured for a period of at least 72 hours. Curing shall be commenced after finishing has been completed and as soon as the concrete has hardened sufficiently, to permit application of the curing material without marring the surface.
- B. Wet burlap, white-pigmented curing compound, waterproof paper or polyethylene sheets may be used for the curing.

END OF SECTION #32 13 14

SECTION #32 13 73 – CONCRETE PAVING JOINT SEALANTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All applicable provisions of the Bidding and Contract Requirements, and Division 1 – General Requirements shall govern the work under this section.

1.2 WORK INCLUDED

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and asphalt pavement.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated. In the event of a discrepancy between this specification section and the City Design Criteria, the City's Design Criteria shall govern. The Contractor shall notify the Engineer in the event of a discrepancy.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
 - 2. When joint substrates are wet or covered with frost.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 – PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.
 - 1. Available Products:
 - a. Crafc0 Inc.; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.

- B. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Available Products:

- a. Crafcro Inc.; RoadSaver Silicone SL.
- b. Dow Corning Corporation; 890-SL.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

1. Available Products:

- a. Crafcro Inc.; Superseal 444/777.
- b. Meadows, W. R., Inc.; Poly-Jet 3406.

- B. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

1. Available Products:

- a. Koch Materials Company; Product No. 9005.
- b. Koch Materials Company; Product No. 9030.
- c. Meadows, W. R., Inc.; Sealtight Hi-Spec.
- d. Approved equals.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
- D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 - 1. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION #32 13 73

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Posts, rails, and frames.
 - 2. Wire fabric.
 - 3. Concrete.
 - 4. Manual gates with related hardware.
 - 5. Automatic gate operators.
 - 6. Accessories.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete anchorage for posts.
 - 2. Section 08 71 00 - Door Hardware: Gate locking device.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- F. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.
- G. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).
- H. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).
- I. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction; 2020.
- J. BHMA A156.3 - Exit Devices; 2020.
- K. CLFMI CLF-FIG0111 - Field Inspection Guide; 2014.
- L. CLFMI CLF-PM0610 - Product Manual; 2017.
- M. CLFMI CLF-SFR0111 - Security Fencing Recommendations; 2014.
- N. CLFMI WLG 2445 - Wind Load Guide for the Selection of Line Post and Line Post Spacing; 2023.
- O. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.
- P. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- Q. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- R. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- S. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- T. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Design Calculations: For high wind load areas, provide calculations for fence fabric and accessory selection as well as line post spacing and foundation details. See CLFMI WLG 2445 for line post and spacing guidance.
- D. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. Refer to CLFMI CLF-SFR0111 for planning and design recommendations.
- E. Samples: Submit two samples of fence fabric, slat infill, 4 inches by 4 inch in size illustrating construction and colored finish.
- F. Manufacturer's Installation Instructions: Indicate installation requirements.
- G. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.
- H. Field Inspection Records: Provide installation inspection records that include post settings, framework, fabric, barbed wire, fittings and accessories, gates, and workmanship.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Fence Installer: Company with demonstrated successful experience installing similar projects and products, with not less than five years of documented experience.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Chain Link Fences and Gates:
 - a. Master-Halco, Inc: www.masterhalco.com/#sle.
 - b. Merchants Metals: www.merchantsmetals.com/#sle.
 - c. American Fence and Supply Co.
 - d. Anchor Fence.
 - 2. Automatic Gate Operators:
 - a. Tymetal Corp; : www.tymetal.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 COMPONENTS

- A. Line Posts: 1.9 inch (48 mm) diameter.
- B. Curved Line Posts: 1.9 inch (48 mm) diameter formed with a 55 degree angle in the direction of the climber.
- C. Corner and Terminal Posts: 2.38 inch (60 mm) diameter.
- D. Curved Corner and Terminal Posts: 2.38 inch (60 mm) diameter formed with a 55 degree angle in the direction of the climber.
- E. Gate Posts: 3-1/2 inch (89 mm) diameter.
- F. Curved Gate Posts: 3-1/2 inch (89 mm) diameter formed with a 55 degree angle in the direction of the climber.
- G. Top and Brace Rail: 1.66 inch (42 mm) diameter, plain end, sleeve coupled.
- H. Bottom Rail: 1.66 inch (42 mm) diameter, plain end, sleeve coupled.
- I. Gate Frame: 1.66 inch (42 mm) diameter for welded fabrication.
- J. Fabric with Pre-Inserted Slats: 2 inch (51 mm) diamond mesh interwoven wire, 6 gauge, 0.1920 inch (4.9 mm) thick, top selvage knuckle end closed, bottom selvage knuckle end closed.
 - 1. Privacy Slats: Vinyl, woven into fabric.
 - a. Visual Barrier: 95 percent.
 - b. Slat Color: Black,
 - 2. Products:
 - a. Noodle Link Plus as manufactured by Privacy Link.
 - 3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- K. Tension Wire: 6 gauge, 0.1920 inch (4.9 mm) thick steel, single strand.
- L. Tie Wire: Aluminum alloy steel wire.

2.3 MATERIALS

- A. Posts, Rails, and Frames:
 - 1. ASTM A1011/A1011M, Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi (345 MPa); zinc coating complying with ASTM F1043 and ASTM F1083.
 - 2. Formed from hot-dipped galvanized steel sheet, ASTM A653/A653M, HSLAS, Grade 50, with G90 (Z275) zinc coating.
 - 3. Line Posts: Type I round in accordance with FS RR-F-191/1D.
 - 4. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
- B. Wire Fabric:
 - 1. ASTM A392 zinc coated steel chain link fabric.
 - 2. Comply with CLFMI CLF-PM0610.
- C. Concrete:
 - 1. Type specified in Section 03 30 00 - Cast-in-Place Concrete.

2.4 MANUAL GATES AND RELATED HARDWARE

- A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.
- B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches (1,525 mm) high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

- C. Hinges: Finished to match fence components.
 - 1. Brackets: Round.
 - 2. Mounting: Center.
 - 3. Closing: Manual.
 - 4. Products:
 - a. D&D Technologies USA, Inc: www.ddtech.com/#sle.
 - 5. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- D. Latches: Finished to match fence components.
 - 1. Brackets: Round.
 - 2. Locking: Magnetic.
 - 3. Products:
 - a. D&D Technologies USA, Inc: www.ddtech.com/#sle.
 - 4. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.5 AUTOMATIC GATE OPERATORS

- A. Swinging Gates: Pre-wired, pedestal mounted gate operator for horizontal swinging gates, per ASTM F2200 and UL 325.
 - 1. Class: Class II
 - 2. Operating type: Swing arm.
 - 3. Control Functions: Open, pause, and close.
 - 4. Maximum Open/Close Time: 10 seconds.
 - 5. Access: Card.
 - 6. Maximum Gate Weight: 500 pounds (187 kilograms).
 - 7. Horsepower Rating: Suitable for connected load.
 - 8. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - 9. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - a. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - b. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- B. Sliding Gates: Pre-wired, pedestal mounted gate operator for horizontal sliding gates, per ASTM F2200 and UL 325.
 - 1. Class: Class II.
 - 2. Operating type: Drive belt.
 - 3. Control Functions: Open, Pause, Close.
 - 4. Maximum Open/Close Time: 10 seconds.
 - 5. Access: Card.
 - 6. Maximum Gate Weight: 500 pounds (187 kilograms).
 - 7. Horsepower Rating: Suitable for connected load.
 - 8. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - 9. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - a. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - b. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

2.6 LIGHT-DUTY ARCHITECTURAL HARDWARE

- A. Exit Devices: Aluminum, 36 inches (914 mm) wide.

1. Performance Criteria: Comply with BHMA A156.3, Grade 1.
2. Provide strike of type recommended by manufacturer for application indicated.
3. Aluminum Finish: 628.
4. Products:
 - a. DAC Industries, Inc; Detex Exit Bar: www.dacindustries.com/#sle.
- B. Mechanical Latches: Steel latch, with mounting bracket for a nominal 1-5/8 inches (41 mm) diameter pipe post frame.
 1. Auto-Latches: Push-rod, self-latching, padlockable assembly.
 - a. Swing Direction: Both ways.
 - b. Mounting to Gate Frame: U-bolts.
 - c. Locking: Padlockable from either side.
 2. Single-Point Latches for Two-Leaf Gates: Pivoting double latch and strike assembly.
 - a. Adjustment Range: Designed for gaps of 2-1/2 to 6 inches (64 to 152 mm) between gate leaf frames.
 - b. Mounting to Gate Frame: U-bolts.
 - c. Locking: Padlockable from either side.
 3. Finish: Galvanized.
 4. Products:
 - a. DAC Industries, Inc; Commercial Strong Arm: www.dacindustries.com/#sle.
 5. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- C. Roller Assembly: Steel chassis assembly with permanently-lubricated and sealed roller bearings.
 1. Weight Rating: 1,000 pound (454 kg).
 2. Shaft: 1 inch (25.4 mm) diameter hardened steel shaft.
 3. Roller: Polymer casting, secured to shaft with nylon locknut.
 4. Protective Cover: Manufacturer's standard UV-inhibited molded polyethylene casting.
 - a. Color: Gray.
 5. Mounting to Round Fence Post: U-bolts.
 6. Finish: Galvanized.
 7. Products:
 - a. DAC Industries, Inc; Stealth Cantilever Roller: www.dacindustries.com/#sle.
 8. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- D. Hinge Set: Self-closing, for top and bottom support of swinging gate.
 1. Swing Direction: One way.
 2. Mounting to Round Fence Post and Gate Frame: Integral clamp.
 3. Finish: Galvanized.
 4. Products:
 - a. DAC Industries, Inc; Residential Self-closing Hinge Sets: www.dacindustries.com/#sle.
 5. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.7 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.
- C. Privacy Slats: Aluminum strips, sized to fit fabric weave.
 1. Products:
 - a. PrivacyLink; Noodle Link Plus.: www.eprivacylink.com/#sle.
 2. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.8 FINISHES

- A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot (530 g/sq m).
- B. Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing (over coating of 550 g/sq m galvanizing).
- C. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- D. Accessories: Same finish as framing.
- E. Color(s): To be selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that areas are clear of obstructions or debris.
- B. Preinstallation Testing: Test areas for ledge.

3.2 PREPARATION

- A. Removal: Obstructions or debris.

3.3 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.
- E. Install center brace rail on corner gate leaves.
- F. Do not stretch fabric until concrete foundation has cured 28 days.
- G. Stretch fabric between terminal posts or at intervals of 100 feet (30 m) maximum, whichever is less.
- H. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches (380 mm) on centers.
- I. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- J. Do not attach the hinged side of gate to building wall; provide gate posts.
- K. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- L. Install gate locking device specified in Section 08 71 00 - Door Hardware.
- M. Peen all bolts upon installation.
- N. Perform three random field inspections confirming proper installation.
- O. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm).
- B. Maximum Offset From True Position: 1 inch (25 mm).
- C. Do not infringe on adjacent property lines.

3.5 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Post Settings: Randomly inspect three locations against design for:
 - 1. Hole diameter.
 - 2. Hole depth.
 - 3. Hole spacing.
- D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
- E. Gates: Inspect for level, plumb, and alignment.
- F. Workmanship: Verify neat installation free of defects. See CLFMI CLF-FIG0111 for field inspection guidance.

3.6 CLEANING

- A. Leave immediate work area neat at end of each work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Refer to Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.7 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures, for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION 32 31 13

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SECTION 32 31 16 – WELDED WIRE FENCES AND GATES

PART 1 GENERAL

1.01 SCOPE OF WORK

Work described in this section includes materials, equipment, labor costs, including shipping of fences, gates and accessories.

1.02 RELATED WORK (Sections to consult)

- A. Division 03 – Concrete
- B. Division 04 – Masonry
- C. Division 31 – Earthwork
- D. Division 32 – Exterior Improvements

1.03 REFERENCES

ASTM STANDARDS: American Society for Testing and Materials

A121 - 19	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
A123 / A123M - 17	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153 / A153M - 16a	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A500 / A500M - 18	Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Round Shapes.
A505 - 16	Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements
A513/A513M - 19	Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
A641/A641M - 09a (2014)	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
A653/A653M - 19	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A659/A659M - 18	Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled
A787/A787M - 15a	Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing
A853 - 24 (2017)	Standard Specification for Steel Wire, Carbon, for General Use
A1008 / A1008M - 18	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A1064 / A1064M - 18a	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
B6 - 18	Standard Specification for Zinc

1.04 SUBMITTALS

- A. Product Data: Material descriptions, dimension of individual components and profiles, and finishes for the following:
 - 1. Fence, gate posts, brackets, rails and fittings.
 - 2. Gates and hardware.
- B. Shop Drawings: In accordance to Section 01 33 00 with six (6) copies:
 - 1. Show locations of fence, each gate, posts, rails, and details of gate swing direction, or other operation, hardware, and accessories.
 - 2. Indicate materials, dimensions, sizes, weights, and finishes of components.
 - 3. Include plans, elevations, sections, gate swing direction and other required installation and operational clearances, and details of post anchorage, attachment and bracing.
 - 4. Installation recommendations and instructions by manufacturer describing all details for a typical fence and gates.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installations of fences and gates similar in material, design, and extent to those indicated for this project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Fences and Gates: Obtain each color, grade, finish, type, and variety of components for fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify local utility making services before beginning work.
 - 2. Unless otherwise indicated in the general provisions of the contract, notify the Architect no less than two (2) days in advance of proposed utility interruptions.
 - 3. Do not proceed with utility interruptions without Architect's written permission.
- B. Field Measurements: Verify layout information for fences and gates shown on drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 PRODUCTS

2.01 MANUFACTURER

OMEGA II FENCE SYSTEMS™

A division of Metaltech - Omega Inc.
1735, St-Elzéar west
Laval (Quebec), Canada
H7L 3N6

Tel: 800-836-6342 / 450-686-9600
Fax: 450-681-5318
Email: customerservice@omegatwo.com
Web site: www.omegatwo.com

2.02 COATINGS

- A. Zinc coating:
 - 1. Wire meshes are coated with 0.5 oz/ft² (150 g/m²) zinc in conformity with ASTM A641 Class 1.
 - 2. Square fence posts, swing gate frame and posts:
 - a. Thickness of 11GA (0.120 in or 3.0 mm) or less: Zinc coated (pre-galvanized process) with a minimum of 0.9 oz/ft² (275 g/m²) as per ASTM A653 Grade 90.
 - b. Thickness over 1/8 in (3.2 mm): Coated with a minimum of 2.3 oz/ft² (705 g/m²) zinc (hot-dip galvanizing) in conformity with ASTM A123 Grade 100.
- B. Polyester Coating:

Polyester coating to be minimum 4 mils applied by an electrostatic process. Coating shall cover all surfaces of the wire and post sections. Coating shall be capable of withstanding the following tests:

 - 1. Mechanical adhesion test as per ASTM D3359 - Method B.
 - 2. Shock resistance tests as per ASTM D2794.
 - 3. Salt spray testing with a minimum of 1 000 hours without red rust appearance, as per ASTM B117.
 - 4. Humidity resistance in a weather meter chamber as per ASTM D2247.
 - 5. Exposure to ultraviolet light with exposure of 1 000 hours using apparatus Type E and 63°C as per ASTM D1499.
- C. Polyester Surface Coating Colors:
 - 1. Standard Coating: Black, RAL 9004 (30% Gloss).

2.03 MATERIALS

2.03.1 MODEL "ELITE" FENCE AND ACCESSORIES

A. Panel Height:

1. 4-foot-high nominal panels: 48-7/16 in (1 230 mm).
2. 6-foot-high nominal panels: 72-7/16 in (1 830 mm).
3. 8-foot-high nominal panels: 96-7/16 in (2 430 mm).
4. Multiple of stacked panels.

B. Model "ELITE" – Steel Mesh Fence Panels:

1. 98-5/8 in (2505 mm) wide, welded by one vertical wire of 6 gauge (0.192 in or 4.9 mm) placed between two horizontal wires of 4 gauge (0.225 in or 5.72 mm) to form rectangles 1-15/16 x 7-7/8 in (50.0 x 200.0 mm).
2. Cold rolled annealed wire made of AISI Grade 1018 steel with tensile strength of at least 75 000 psi (515 Mpa) in accordance with ASTM A853.
3. One end of the vertical wires of the panel shall extend 1 in (25.4 mm) from the last or the first horizontal wire to create a spiked top or bottom depending on installed position. The other end is cut flush.
4. Panel camber may not exceed 0.094 in (2.5 mm).

C. Square Posts:

Cold rolled 1008 grade steel to meet ASTM A500 and ASTM A787 and the following maximum horizontal loads, length as required for installation type:

The length of the posts is minimum 36 in (914 mm) more than the actual height of the fence for installation in the ground depending on local land code requirements (frost line).

1. Installation
 - a. In ground, post length as required for local frost line requirements
2. Post Size

Post Size	Gauge	Maximum horizontal load
2 in x 2 in (50.8 mm x 50.8 mm)	11 (3.0 mm)	289 pounds (1 286 N)
3 in x 3 in (76.2 mm x 76.2 mm)	11 (3.0 mm)	691 pounds (3 074 N)

D. Post Brackets:

1. Universal Collar Bracket Kit: Universal bracket for standard use on line or end posts. Includes the following: 14 gauge (1.9 mm) steel collar and wire retaining plate 1/4 in x 1 in (6.4 mm x 25.4 mm), nut, washer and carriage bolt 5/16 in x 1-1/4 in (7.9 mm x 31.8 mm), all galvanized steel.
 - a. For 90° turn, use the same bracket
 - b. For different angles, used the "Universal collar angle brackets".
 - c. For 4-foot-high nominal panels: Provide 6 brackets per panel.
 - d. For 6-foot-high nominal panels: Provide 6 brackets per panel.
 - e. For 8-foot-high nominal panels: Provide 8 brackets per panel.

E. Post caps:

1. Aluminum alloy: For dimension posts 2 in x 2 in (50.8 mm x 50.8 mm), 3 in x 3 in (76.2 mm x 76.2 mm) and 4 in x 4 in (101.6 mm x 101.6 mm).
2. Galvanized steel: For larger dimensions.

2.03.2 SINGLE / DOUBLE SWING GATES

1. Single swing.

B. Gate Frames:

1. Two (2) 16 gauge (1.6 mm) 1-1/2 in x 1-1/2 in (38.1 mm x 38.1 mm) horizontal tubes and two (2) 11 gauge (3.0 mm) 2 in x 2 in (50.8 mm x 50.8 mm) vertical tubes, welded at intersections to create a rigid frame, in accordance with ASTM F900.

C. Gate Posts:

Cold rolled from 1008 grade steel to meet ASTM A500 and ASTM A787. Posts are to include cap and SPF-W Kit for adjacent panel mounting. Length as required for installation type:

1. Installation:
 - a. In ground, post length as required for local frost line requirements

Opening Dimension	Post Size
3 ft to 7 ft	3 in x 3 in (76.2 mm x 76.2 mm) 11 gauge (3.0 mm)
> 7 ft to 9 ft	4 in x 4 in (101.6 mm x 101.6 mm) 11 gauge (3.0 mm)
> 9 ft to 19 ft	6 in x 6 in (152.4 mm x 152.4 mm) 3/16 in (4.8 mm)

D. Gate Hardware:

1. Standard Hardware: Hot-dip galvanized steel in conformity with ASTM F900, sized to assure proper gate operation. Non-moving parts shall be powder coated.
 - a. Hinge: Structurally designed to support all gates without deformation during opening and closing.
 - b. Latch: Clamp-on gravity system that is self latching. Includes the following:
 - Self-locking Device: With padlock eyes as an integral part of latch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
- B. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 ft (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 IN-GROUND CONCRETE INSTALLATION

- A. Install fencing on established boundary lines inside property line
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed or compacted soil.
- C. Post Setting: Set posts in concrete footing. Protect portion of posts above ground from concrete splatter. Place concrete around posts and consolidation. Using mechanical devices to set posts is not permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.
 1. Dimensions and Profile: As indicated on Drawings.
 2. Space line posts uniformly at center to center.
 3. Exposed Concrete Footings: Extend concrete 2 in (50.8 mm) above grade. Smooth and shape to shed water.

4. Concealed Concrete Footings: Stop footings [2 in (50.8 mm) <Insert dimension> below grade [as indicated on Drawings] to allow covering with surface material.
5. Posts Set into Concrete in Sleeves: Use steel pipe sleeves pre-set and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with [non shrink, non-metallic grout,] [anchoring cement,] mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
6. Posts Set into Concrete in Voids: Form or core drill holes not less than 5 in (125 mm) deep and 3/4 in (19.1 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill granular space between post and concrete with [non-shrink, non-metallic grout,] [anchoring cement,] mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
7. Flange Post Installation: Bolt mounting plates attached to each post to slab or structure as indicated, using expansion bolts.

3.04 FENCE INSTALLATION – Model “ELITE”

- A. Install the fence along the specified layout according to the drawings. The fence panel shall be installed to maintain a clear minimum distance of 1-1/4 in (31.8 mm) and a maximum distance of 2 in (50.8 mm) from the ground surface. Holes for posts shall be at least 8 in (200 mm) in diameter and at least 42 in (1 070 mm) deep.
- B. Posts shall be adequately supported within the concrete forms to maintain the required positioning and prescribed level until concrete has set. All necessary anchors and posts shall be at a minimum depth of 36 in (914 mm) into the ground.
- C. Square Post Installation: Once the concrete is set, the fence sections are fastened to the posts with the desired bracket type.
 - a. Universal Collar Bracket Kit: Brackets slot allows for adjustments of $\pm 1\text{-}1/2$ in (38.1 mm) on each side. Always install the brackets flush with horizontal wire of the panel (no gap).

Post Size	Post Spacing C/C
2 in x 2 in (50.8 mm x 50.8 mm)	103-5/8 in (2 631 mm)
3 in x 3 in (76.2 mm x 76.2 mm)	104-5/8 in (2 657 mm)

- D. For the fence to follow slopes, it is required to step the fence sections. The Universal bracket on square posts can be slid along the post at the desired height and should always be install flush with horizontal wire (no gap). When faced with a steep slope, it will be necessary to order longer posts and panels cut in half as to keep the gap under the panel to a minimum.
- E. Upon cutting or trimming a post or a wire mesh section, apply a zinc rich primer to the exposed ends and finish with the matching touch-up paint supplied by the manufacturer.
- F. Panels must be installed as instructed by client:
 1. Spikes pointed up or down for safety

3.05 CAST-IN-PLACE CONCRETE

- A. General: Comply with ACI 301 for cast-in-place concrete.
- B. Materials: Portland cement complying with ASTM C150 <Insert type if required>, aggregates complying with ASTM C33, and potable water [for ready-mixed concrete complying with ASTM C94]. [Measure, batch, and mix Project-site-mixed concrete according to ASTM C94.]
- C. Concrete Mixture: Normal-weight concrete with not less than 3 000 psi (20.7 Mpa) compressive strength (28 days), 3 in (76.2 mm) slump, and contain “coarse aggregate” of a minimum diameter of 1/5 in (5.1 mm) to a maximum of 3/4 in (19.1 mm) maximum size aggregate. A 5% to 7% air entrained or according to recommendation of section 03 00 00.

3.06 GROUT AND ANCHORING CEMENT

- A. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

3.07 GATE INSTALLATION AND ADJUSTMENT

- A. Install gate posts in accordance with manufacturer's instructions.
- B. Concrete Set Gate Posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have a diameter 4 times greater than outside dimension of post, and depths approximately 6 in (150 mm) deeper than frost level. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 in (914 mm) below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope to direct water away from posts. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.
- C. Install gates perfectly horizontal and levelled (at junction), plumb, and secure for full opening without interference.
- D. Attach hardware so to have the nuts inside the property thus making the assembly tamper-proof which will prevent unauthorized removal. Install ground-set items in concrete for anchorage.
- E. Adjust hardware for smooth operation and lubricate where necessary to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.08 MAINTENANCE

- A. Inspection
 - 1. A thorough visual inspection shall be done annually.
 - 2. This inspection must include overall verification of physical condition.
- B. Moveable parts shall be adjusted, if needed, every five (5) years, unless project requires additional inspections.
- C. In areas of extreme winter conditions, entire installation must be free of excessive ice and snow accumulation.

32 31 19 - DECORATIVE METAL FENCES AND GATES

Part 1 – GENERAL

1.01 SCOPE OF WORK

Work described in this section includes materials, equipment, labor costs, including shipping of fences, gates and accessories.

1.02 RELATED WORK (Sections to consult)

- A. Division 03 – Concrete
- B. Division 04 – Masonry
- C. Division 31 – Earthwork
- D. Division 32 – Exterior Improvements
- E. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 REFERENCES

ASTM STANDARDS: American Society for Testing and Materials

A123 / A123M - 17	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A153 / A153M - 16a	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A500 / A500M - 18	Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Round Shapes.
A505 - 16	Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements
A513/A513M - 19	Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
A641/A641M - 09a (2014)	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
A653/A653M - 19	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A659/A659M - 18	Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled
A787/A787M - 15a	Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing
A853 - 24 (2017)	Standard Specification for Steel Wire, Carbon, for General Use
A1008 / A1008M - 18	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
A1064 / A1064M - 18a	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
B6 - 18	Standard Specification for Zinc
B22 - 14	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
B209 – 14	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B210 / B210M – 19a	Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
B221 – 20	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
D2247 - 15	Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
D2794 - 93 (2014)	Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
D3359 - 17	Standard Test Methods for Measuring Adhesion by Tape.
F626 - 14 (2019)	Standard Specification for Fence Fittings
F900 - 11 (2017)	Standard Specification for Industrial and Commercial Swing Gates.

F934 - 96 (2017)	Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
F1043 - 18	Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.
F1184 - 16	Standard Specification for Industrial and Commercial Horizontal Slide Gates.
F2919 / F2919M - 12 (2018)	Standard Specification for Welded Wire Mesh Fence Fabric (Metallic-Coated or Polymer Coated) with Variable Mesh Patterns or Meshes Greater than 6 in ² [3871 mm ²] in Panels
F2957 - 13(2019)e1	Standard Specification for Ornamental Aluminum Fence Systems

1.04 SUBMITTALS

- A. Product Data: Material descriptions, dimension of individual components and profiles, and finishes for the following:
 - 1. Fence, gate posts, brackets, rails and fittings.
 - 2. Gates and hardware.
- B. Shop Drawings: In accordance to Section 01 33 00 with six (6) copies:
 - 1. Show locations of fence, each gate, posts, rails, and details of gate swing direction, or other operation, hardware, and accessories.
 - 2. Indicate materials, dimensions, sizes, weights, and finishes of components.
 - 3. Include plans, elevations, sections, gate swing direction and other required installation and operational clearances, and details of post anchorage, attachment, and bracing.
 - 4. Installation recommendations and instructions by manufacturer describing all details for a typical fence and gates.

1.05 SUBSTITUTION OF PRODUCTS

To enable all tenders to be judged equitably, they shall be based on the specified products in this document and shown on the drawings:

- A. The proposal for any substitute products must be attached to their tender separately, identifying the substitution product by its trade name along with any savings it may represent.
- B. Following the opening of the tender, only the substitutions proposed by the lowest bidder of the specified products will be considered.
- C. All substitutions approval requests shall be accompanied by manufacturing drawings and specifications, and they meet all specifications for design, size gauge of metal parts and fabrication.
- D. Each substitution sample must be presented to the owner/consultant within seven days following the opening of tenders. After this time, the bidder will be required to supply the original specified product.
- E. The owner/consultant reserves the right to grant or deny approval for proposed substitutions without prejudice to this right and the decision shall be final.
- F. Fencing products must be entirely interchangeable, if applicable, with already installed material.
- G. The above conditions apply to this section independently of any other clauses on the subject found in this document.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installations of fences and gates similar in material, design, and extent to those indicated for this project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Fences and Gates: Obtain each color, grade, finish, type, and variety of components for fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify local utility making services before beginning work.
 2. Unless otherwise indicated in the general provisions of the contract, notify the Architect no less than two (2) days in advance of proposed utility interruptions.
 3. Do not proceed with utility interruptions without Architect's written permission.
- B. Field Measurements: Verify layout information for fences and gates shown on drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

Part 2 – PRODUCTS

2.01 MANUFACTURER

OMEGA II FENCE SYSTEMS™

A division of Metaltech - Omega Inc.
1735, St-Elzéar west
Laval (Quebec), Canada
H7L 3N6

Tel: 800-836-6342 / 450-686-9600
Fax: 450-681-5318
Email: customerservice@omegatwo.com
Web site: www.omegafence.com

- A. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirement:
1. All substitution approval requests shall be accompanied by manufacturing drawings and specifications, and they shall meet all specifications for design, size, gauge of metal parts, and fabrication.

2.02 COATINGS

- A. Zinc coating:
1. Square fence posts, swing gate frame and posts:
 - a. Thickness of 11GA (0.120 in or 3.0 mm) or less: Zinc coated (pre-galvanized process) with a minimum of 0.9 oz/ft² (275 g/m²) as per ASTM A653 Grade 90.
 - b. Thickness over 1/8 in (3.2 mm): Coated with a minimum of 2.3 oz/ft² (705 g/m²) zinc (hot-dip galvanizing) in conformity with ASTM A123 Grade 100.
 2. Flat posts are coated with a minimum of 2.3 oz/ft² (705 g/m²) zinc (hot-dip galvanizing) in conformity with ASTM A123 Grade 100.
- B. Polyester Coating:
- Polyester coating to be minimum 4 mils applied by an electrostatic process. Coating shall cover all surfaces of the wire and post sections. Coating shall be capable of withstanding the following tests:
1. Mechanical adhesion test as per ASTM D3359 - Method B.
 2. Shock resistance tests as per ASTM D2794.
 3. Salt spray testing with a minimum of 1 000 hours without red rust appearance, as per ASTM B117.
 4. Humidity resistance in a weather meter chamber as per ASTM D2247.
 5. Exposure to ultraviolet light with exposure of 1 000 hours using apparatus Type E and 63°C as per ASTM D1499.
- C. Polyester Surface Coating Colors:
1. Standard Coating: Reference L2.00 for color. Color to be selected from Omega's Standard RAL catalog.

2.03 MATERIALS

2.03.1 MODEL "OMEGA UNIK" FENCE AND ACCESSORIES

A. Panel Nominal Dimensions:

1. Vertical panels of 6 ft H. x 4 ft W.: 67-3/4 in x 44 in (1 721 mm x 1 118 mm)
2. Vertical panels of 8 ft H. x 4 ft W.: 91-3/4 in x 44 in (2 330 mm x 1 118 mm)
3. Horizontal panels of 4 ft H. x 6 ft W.: 43-3/4 in x 68 in (1 111 mm x 1 727 mm)
4. Horizontal panels of 4 ft H. x 8 ft W.: 43-3/4 in x 92 in (1 111 mm x 2 337 mm)
5. Custom

B. Perforated Panels:

1. Made of 5052-H32 aluminium sheet, 1/8 in (3.2 mm) thick.
2. 2 in (50.8 mm) folds are typically made on all four (4) sides of the panel.
3. 1 in (25.4 mm) buffer is reserved on the circumference of the panel (after folds) before the beginning of extruding the selected design.
4. It is possible to stack two (2) vertical panels to double the fence height. The panels are joined together with hexagonal screws and tamper-proof nuts.
5. Rectangular holes of 1/2 in x 3/8 in (12.7 mm x 9.5 mm) are made on panel folded sides to attach itself to posts or other panels if needed,

C. Square Posts:

Posts are made of cold-formed AISI 1008 steel to meet ASTM A500 and ASTM A787 and the following maximum horizontal loads, length as required for installation type:

The length of the posts is minimum 36 in (914 mm) more than the actual height of the fence for in-ground installation, depending on local land code requirements (frost line).

1. Installation
 - a. In-ground, post length as required for local frost line requirements.
 - b. Surface mounted, flanged.
2. Post Size:
 - a. 2 in x 2 in (50.8 mm x 50.8 mm) x 11 gauge (0.12 in or 3.0 mm)

E. Post Brackets:

1. **Standard Bolt System:** For installation on flat posts with panels in straight line. Includes the following: 5/16 in (7.9 mm) tamper-proof nut and carriage bolt, all stainless steel.
 - a. For vertical panels: 3 bolts per post
 - b. For horizontal panels: 2 bolts per post
 - c. For stacked horizontal panels: 2 bolts per post and 3 additional bolts per set of stacked panels
 - d. Custom for non-standard panel sizes

F. Post caps:

1. Aluminum alloy: For dimension posts 2 in x 2 in (50.8 mm x 50.8 mm), 3 in x 3 in (76.2 mm x 76.2 mm) and 4 in x 4 in (101.6 mm x 101.6 mm).
2. Galvanized steel: For larger dimensions.

G. Polyester powder coating: (See article 2.02B).

H. Concrete: (See article 3.05B)

2.03.2 SINGLE / DOUBLE SWING GATES

A. Configuration:

1. Single swing.

B. Gate Frame:

1. Two (2) horizontal tubes and two (2) vertical tubes, all 2 in x 2 in (50.8 mm x 50.8 mm) 16 gauge (1.6 mm) square tubes, welded at intersections to create a rigid frame, in accordance with ASTM F900.
2. Two (2) 16 gauge (1.6 mm) 2 in x 2 in (50.8 mm x 50.8 mm) horizontal tubes and two (2) 11 gauge (3.0 mm) 2 in x 2 in (50.8 mm x 50.8 mm) vertical tubes, welded at intersections to create a rigid frame, in accordance with ASTM F900.

C. Gate Posts:

Cold rolled from 1008 grade steel to meet ASTM A500 and ASTM A787. Posts are to include cap and are fixed to the door frame using two (2) hinges. Length as required for installation type:

1. Installation:
 - a. In-ground, post length as required for local frost line requirements.
2. Post Size:

Opening Dimension	Post Size
3 ft to 8 ft	3 in x 3 in (76.2 mm x 76.2 mm) 11 gauge (3.0 mm)
> 8 ft to 10 ft	4 in x 4 in (101.6 mm x 101.6 mm) 11 gauge (3.0 mm)
> 10 ft to 19 ft	6 in x 6 in (152.4 mm x 152.4 mm) x 3/16 in (4.8 mm)

D. Gate Hardware:

1. Standard Hardware:
 - a. Hinge: Structurally designed to support all gates without deformation during opening and closing. Allows a 180° rotation during both opening and closing.
 - b. Latch: Keyed Lock system that is self latching and equipped with a mechanism to lock the barrier. The latch allows the gate to be opened and closed from both sides.
 - Barrier support: this support is installed when the barrier measures 1524 mm (5 ft) and more. The gate support is used to hold and support the gate in the fully open position.
2. Additional Hardware for Double Gates:
 - a. Drop bar: Secure one gate in closed position, with stop pipe to engage the center drop rod.
3. Optional Hardware:
 - a. Panic Bar and Plate: (Dorex 8500). For quick exit during an emergency. [Replace Standard Latch]
 - b. Kick Plate: Solid plate added to both sides of the gate.
 - c. Other: [Insert brand and model of optional hardware required]

E. Polyester Coating: (See article 2.02B)

F. Concrete: (See article 3.05)

2.03.3 CANTILEVER GATES

Omega II cantilever gates shall be fabricated in accordance with ASTM F1184 Class 2 as well as F2200 when gate is automated. Gate frame members are all made of aluminum extrusions 6061-T6 following ASTM B221. Each gate frame consists of a top track, a bottom track, vertical uprights and diagonal braces. Components shall be welded together forming a rigid one-piece frame integrating the top and bottom track. Vertical uprights shall be positioned on the gate frame, up to approximately 8 ft (2 438 mm) apart and dividing the opening section of the frame into equal sections as well as the tail section, each opening section will be reinforced with one (1) diagonal brace and each tail section will be cross braced using two (2) diagonal braces.

Each gate has an overall length equal to 1.5x its single opening (opening and overhang). An additional distance equal to the gate single opening length must be kept unobstructed to one side of the single cantilevered gate for opening functionality (also applies to double slide gates). Therefore, an entire distance equal to 2.5x the gate single opening is required in total for each gate to allow opening and closing functionality.

A. Gate Posts: Gate posts shall be 4 in (101.6 mm) hot-dipped galvanized steel square sections. Pipe shall have a minimum 1.8 oz/ft² (549 g/m²) zinc coating meeting ASTM F1234. The steel shall meet requirements of ASTM A500, Grade B with a minimum yield strength of 40 000 psi (276 MPa). The length of the posts is minimum 36 in (914 mm) more than the actual height of the fence for installation in the ground depending on local land code requirements (frost line). Double track are to be used with operators on larger gates.

1. Single cantilevered gate:
 - a. Single track: 1 latch post and 2 support posts.
 - b. Double track: 1 latch post and 4 support posts.

Gate single opening	Overhang length	Overall length
4 ft (1 219 mm)	2 ft (609 mm)	6 ft (1 828 mm)
8 ft (2 438 mm)	4 ft (1 219 mm)	12 ft (3 657 mm)
16 ft (4 876 mm)	8 ft (2 438 mm)	24 ft (7 315 mm)
24 ft (7 315 mm)	12 ft (3 657 mm)	36 ft (10 972 mm)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
- B. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 ft (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 IN-GROUND CONCRETE INSTALLATION

- A. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed or compacted soil.
- C. Post Setting: Set posts in concrete footing. Protect portion of posts above ground from concrete splatter. Place concrete around posts and consolidation. Using mechanical devices to set posts is not permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.
 1. Dimensions and Profile: As indicated on Drawings.
 2. Space line posts uniformly at center to center.
 3. Exposed Concrete Footings: Extend concrete 2 in (50.8 mm) above grade. Smooth and shape to shed water.
 4. Concealed Concrete Footings: Stop footings [2 in (50.8 mm) <Insert dimension> below grade [as indicated on Drawings] to allow covering with surface material.
 5. Posts Set into Concrete in Sleeves: Use steel pipe sleeves pre-set and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with [non shrink, non-metallic grout,] [anchoring cement,] mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
 6. Posts Set into Concrete in Voids: Form or core drill holes not less than 5 in (125 mm) deep and 3/4 in (19.1 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill granular space between post and concrete with [non-shrink, non-metallic grout,] [anchoring cement,] mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
 7. Flange Post Installation: Bolt mounting plates attached to each post to slab or structure as indicated, using expansion bolts.

3.04 FENCE INSTALLATION – Model “OMEGA UNIK”

- A. Install the fence along the specified layout according to the drawings. The fence panel shall be installed to maintain a clear distance of 2 in (50.8 mm) from the ground surface. Footing for posts shall be at least 8 in (200 mm) in diameter and at least 42 in (1 070 mm) deep.
- B. Posts shall be adequately supported within the concrete forms to maintain the required positioning and prescribed level until concrete has set. All necessary anchors and posts shall be at a minimum depth of 36 in (914 mm) in the ground.

Post Size	Nominal Panel Width	Post Spacing C/C
2 in x 2 in (50.8 mm x 50.8 mm)	4 ft (Vertical Panel)	46 in (1 168 mm)
	6 ft (Horizontal Panel)	70 in (1 778 mm)
	8 ft (Horizontal Panel)	94 in (2 387 mm)
3 in x 3 in (76.2 mm x 76.2 mm)	4 ft (Vertical Panel)	47 in (1 194 mm)
	6 ft (Horizontal Panel)	71 in (1 803 mm)
	8 ft (Horizontal Panel)	95 in (2 413 mm)

- D. For the fence installed in slopes, it is necessary to order longer posts and/or adjust panels height and/or modify the positioning holes in the folds panels to keep a constant gap between the panel and the ground. Consult the manufacturer to obtain a personalized solution for a sloped site.
- E. Upon cutting or trimming a post, apply a zinc rich primer to the exposed ends and finish with the matching touch-up paint supplied by the manufacturer.

3.05 CAST-IN-PLACE CONCRETE

- A. General: Comply with ACI 301 for cast-in-place concrete.
- B. Materials: Portland cement complying with ASTM C150 <Insert type if required>, aggregates complying with ASTM C33, and potable water [for ready-mixed concrete complying with ASTM C94]. [Measure, batch, and mix Project-site-mixed concrete according to ASTM C94.]
- C. Concrete Mixture: Normal-weight concrete with not less than 3 000 psi (20.7 Mpa) compressive strength (28 days), 3 in (76.2 mm) slump, and contain "coarse aggregate" of a minimum diameter of 1/5 in (5.1 mm) to a maximum of 3/4 in (19.1 mm) maximum size aggregate. A 5% to 7% air entrained or according to recommendation of section 03 00 00.
- D. Materials: Dry-packaged concrete mix complying with ASTM C387 for normal-weight concrete mixed with potable water according to manufacturer's written instructions.

3.06 GROUT AND ANCHORING CEMENT

- A. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

3.07 GATE INSTALLATION AND ADJUSTMENT

- A. Install gate posts in accordance with manufacturer's instructions.
- B. Concrete Set Gate Posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have a diameter 4 times greater than outside dimension of post, and depths approximately 6 in (150 mm) deeper than frost level. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 in (914 mm) below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour, tamp for consolidation. Trowel finish around post and slope to direct water away from posts. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.

- C. Install gates perfectly horizontal and levelled (at junction), plumb, and secure for full opening without interference.
- D. Attach hardware so to have the tamper-proof nuts inside the property, which will prevent unauthorized removal. Install ground-set items in concrete for anchorage.
- E. Adjust hardware for smooth operation and lubricate where necessary to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.13 SITE CLEANING

Clean and adjust soil disturbed during work. Get of all surplus and waste materials and replace damaged turf in accordance with directives of Engineer and Consultant.

3.14 MAINTENANCE

- A. Inspection
 - 1. A thorough visual inspection shall be done annually.
 - 2. This inspection must include overall verification of physical condition.
- B. Moveable parts shall be adjusted, if needed, every five (5) years, unless project requires additional inspections.
- C. In areas of extreme winter conditions, entire installation must be free of excessive ice and snow accumulation.

SECTION 32 91 00 - SOIL PREPARATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Furnish components of the planting mediums.
 - 2. Testing and/or certifications of components
 - 3. Mixing of planting mediums.
 - 4. Transporting mediums as required.
 - 5. Weed Control
- B. Related Sections:
 - 1. Finish Grading - Section 31 22 15
 - 2. Sprinkler Irrigation System - Section 32 84 00
 - 3. Lawns and Grasses - Section 32 92 00
 - 4. Planting - Section 32 93 00

1.2 QUALITY ASSURANCE

- A. Certificates of Inspection: Certificates of inspection required for transportation shall accompany invoice for each shipment of materials. File copies of certificates with Landscape Architect after acceptance of material.
- B. Testing:
 - 1. Chemical and Physical - All soil components shall be tested by one of the following testing laboratories for conformity to the specifications:

Texas Plant and Soil Lab
5115 West Monte Cristo
Edinburg, Texas 78539
(956) 383-0739

A&L Plains Agricultural Laboratories, Inc.
302 34th Street
Lubbock, Texas 79404
(806) 763-4278

Soil and Plant Laboratory, Incorporated
Post Office Box 153
Santa Clara, California 95052
(408) 243-0330
 - 2. Biological:

Soil Food Web, Inc.
1128 NE 2nd Street Suite 120
Corvallis, Oregon 97330
www.soilfoodweb.com
(541) 752-5066
 - 3. If herbicide contamination is suspected, then a radish/rye-grass growth trial must be performed.

4. For delivered material, test one grab sample for each fifty (100) cubic yards of bulk material delivered to the site.
5. Testing will be at the expense of Contractor.
6. Deviations greater than plus or minus twenty (20%) percent from control data may be grounds for rejection of mixes tested. Non-conforming materials shall not be used. Materials which do not conform to standards specified herein shall be removed from the site.

1.3 SUBMITTALS:

- A. Furnish copies of manufacturers literature, certifications, sources, samples, or laboratory analytical data for the following items:
1. Existing soil testing data
 2. Organic Amendments and Fertilizers
 3. Planting Soil
 4. Topsoil.
 5. Sand.
 6. Native Mulch (composted).
 7. Compost.
 8. Herbicides
 9. Pre-Emergent Herbicides

PART 2 PRODUCTS

2.1 PLANTING SOIL:

- A. Grading:

Sieve Size	Percent Passing Sieve
25.4 mm (1")	95-100
9.51 mm (3/8")	85-100
53 Micron (270 mesh)	10- 30

- B. Chemistry - Suitability Considerations:

1. Salinity: Saturation Extract Conductivity (ECe x 103 @ 25 degrees C.) less than 2.2 mmhos/cm.
2. Sodium: Sodium Absorption Ratio (SAR) less than 9.0.
3. Boron: Saturation Extract Concentration less than 2.0 ppm.
4. Reaction: pH of Saturated Paste: 6 - 7.5.

- C. Pests:

The population of any single species of plant pathogenic nematode: Fewer than 500 per pint of soil (confirm by biological testing).

- D. Fertility Considerations:

Soil to contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium, and magnesium to support normal plant growth. In the event of nutrient inadequacies, provisions shall be made to add required materials to overcome inadequacies prior to planting.

- E. Source of above shall be approved and conformity of material shall be laboratory verified for each 100 cubic yards of material delivered to the site.

F. Percentage of Organic Matter: Min. 4-8%

- G. Physical Soil Parameters
1. Clay: 5-25%
 2. Silt: 25-50%
 3. Sand: 25-50%

2.2 ON SITE MATERIAL:

- A. Specified backfill mixes shall consist of on site material generally conforming to the requirements in this specification.
- B. Test on site topsoil from designated stockpile area or borrow site for conformity to this specification. Submit test to Landscape Architect for verification and alteration of components.

2.3 WOOD RESIDUALS:

- A. Source:
Shall be non-composted and/or stockpiled, and not have been chemically treated or dyed.

- B. Physical Properties - Grading:

U.S. Sieve Dry Weight Percent Passing

3/8"	100
1/4"	90 - 100
No. 8	70 - 100
No. 35	0 - 30

- C. Organic Content by Ash Analysis:

90 - 100 Percent Dry Weight

- D. Chemistry Range:

1. Saturation Extract Conductivity (ECc) Nil - 3.5
2. Reaction (pH) 6-8

- E. Salinity: Maximum saturation extract conductivity 3.5 millimhos per cm @ 25 degrees centigrade.

2.4 SAND:

- A. Physical Properties - Grading:

U.S. Sieve Percent Passing

No. 4	100
No. 10	95 - 100
No. 18	90 - 100
No. 35	65 - 100
No. 60	0 - 50

No. 140 0 - 20
No. 270 0 - 7

- B. Chemistry: Range:
1. Saturation Extract Conductivity (ECc) Nil - 3.0
 2. Sodium Absorption Ratio (SAR) Nil - 6.0
 3. Boron - ppm in saturation extract solution Nil - 3.0
 4. Reaction (pH) 6.0 - 7.5
 5. Available calcium - sodium acetate extractable - ppm dry weight Nil – 4000
 6. Soluble-Salt Content: 1 to 2dS/m measured by electrical conductivity
 - 7.

- C. Coarse Sand – concrete sand

2.5 **COMPOST:**

Made from recycled natural materials screened to 1" minus (for soil additive). On the Solvita compost maturity test score, must score a value of 5 or higher for tilling into the soil and be a minimum of 6 months old and fully composted. Supplied by Nature's Way Resources, Inc., Conroe, Texas or approved equal.

- A. Chemical components:
1. pH - 6.0-8.0
 2. Nitrogen – 30 ppm or higher
 3. Phosphorus – 150 ppm or higher
 4. Potassium – 400 ppm or higher
 5. Calcium – 3000 ppm or higher
 6. Magnesium – 250 ppm or higher
 7. Salinity – 2500 ppm or lower
 8. Zinc – 6 ppm or higher
 9. Iron – 25 ppm or higher
 10. Manganese – 16 ppm or higher
 11. Copper – 0.4-2.0 ppm
 12. Sodium – 1000 ppm or less
 13. Sulfur – 25 ppm or higher
 14. Boron – 2 ppm or higher
- B. Biological components:
1. Bacteria – minimum of 150 micrograms per gram of soil of total bacteria
 2. Fungus – minimum of 150 micrograms per gram of soil of total fungus
 3. Protozoa
 - a. flagellates – 10,000 units per gram of soil
 - b. amoebae – 10,000 units per gram of soil
 - c. ciliates – 20 units per gram of soil

2.6 **CHEMICAL ADDITIVES (OR EQUIVELANTS):**

The following soil components listed may have a particular application specified within this Section. Some of the soil components included shall be applied at rates determined by the soil tests called for under other paragraphs of this Section or as a result of soil tests. Some of the components may not be required by the soils tests. All additives shall be the slow release type.

- A. Ground Limestone: Agricultural limestone containing not less than eighty five (85%) percent of total carbonates, ground to such fineness that fifty (50%) percent will pass a 100 mesh sieve and ninety (90%) percent will pass a 20 mesh sieve.
- B. Dolomite Lime: Agricultural grade mineral soil conditioner containing thirty five (35%) percent minimum magnesium carbonate and forty nine (49%) percent minimum calcium carbonate, 100 percent passing #65 sieve. Kaiser Dolomite 65 AG or approved equal.
- C. Gypsum: Agricultural grade product containing eighty (80%) percent minimum calcium sulphate.
- D. Iron Sulphate (Ferric or Ferrous): Shall contain thirty (30%) to thirty five (35%) percent iron, thirty five (35%) to forty (40%) percent sulphur and be supplied by a commercial fertilizer supplier.
- E. Sulphate of Potash: Agricultural grade containing fifty (50%) percent to fifty three (53%) percent of water soluble potash.
- F. Single Superphosphate: Commercial product containing nineteen (19%) to twenty (20%) percent available phosphoric acid.
- G. Ammonium Sulphate: Commercial product containing approximately twenty one (21%) percent ammonia.
- H. Calcium Nitrate: Agricultural grade containing fifteen and one-half (15 1/2%) percent Nitrogen.
- I. I.B.D.U. (Iso Butyldiene Diurea): Commercial product containing thirty one (31%) percent Nitrogen.
- J. Soil Sulphur: Agricultural grade sulphur containing a minimum of ninety six (96%) percent sulphur.
- K. Iron Chelate Micronutrient: Sequestrene - 330 Fe; 0-0-0; ten (10%) percent Fe; Ciba-Geigy Company.

2.7 FERTILIZERS AND NUTRIENT AMENDMENTS: all 100% organic

- A. Fertilizer: MicroLife organic fertilizer as supplied by San Jacinto Environmental Supplies, Houston, Texas or approved equal.
- B. Minor and Trace Elements: Humates Plus 0-0-4 as supplied by San Jacinto Environmental Supplies, Houston, Texas or Green Sand as supplied by Nature's Way Resources, Inc. or approved equals.

PART 3 EXECUTION

PLANTING

3.1 LAWN AND NATIVE SEED AREAS – Hydromulch and Sod

- A. After finish grade approval and before laying sod or spreading seed apply:
 - 1. 2" layer of compost uniformly across area
 - 2. 20# of MicroLife 6-2-4 fertilizer per 1,000 sq. ft.
 - 3. 10# of MicroLife humates plus 0-0-4 trace elements per 1,000 sq. ft.

4. After laying sod or spreading seed, foliar spray the entire area with 8oz of MicroLife Super Seaweed mixed with a gal of water. Each gallon of mix to cover 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 2"-4" until the amendments are fully incorporated before seeding and/or planting (See Section 32 92 00).

3.2 SHADED GROUNDCOVER AREAS

- A. After finish grade approval apply:
1. 1" layer of Compost uniformly across area
 2. 3" (in) Planting Soil
 3. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
 4. 10# of MicroLife humates plus 0-0-4 trace elements per 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 4" until the amendments are fully incorporated before groundcover planting (See Section 32 92 00).

3.3 TREE PLANTING AREAS (Within Tree Excavation Pit)

- A. After finish grade approval before mulching apply:
1. Backfill with a 50/50 blend of existing topsoil and Planting Soil
 2. For every 15 gal. tree size, add 6 oz. MicroLife Ultimate 8-4-6
 3. 3 oz of JRM Mycorrhizal Tree Transplant
 4. 2 oz of MicroLife Super Seaweed mixed with a gal. of water. Use 2 gal. of mixed solution per 15-gal. tree size

3.4 SUNNY GROUNDCOVER AND PERENNIAL AREAS

- A. After finish grade approval apply:
1. 4"(in) Planting Soil
 2. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
 3. 10# of MicroGro Granular per 1,000 sq. ft.
 4. 2 oz of MicroLife Maximum Bloom 3-8-3 mixed with a gal. of water as a new plant/root stimulator. Water soak the area sufficiently to get uniform saturation.
- B. Disk or till into the soil to a depth of 6" until the amendments are fully incorporated before planting (See Section 32 93 00).

3.5 SHRUB PLANTING

- A. After finish grade approval before mulching apply:
1. 4"(in) Planting Soil
 2. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 6" until the amendments are fully incorporated before planting (See Section 32 93 00).

3.6 EXISTING TREES (12"+ cal.)

- A. Once a year treatment
1. 2 gal. of MicroLife Bio-Matrix 7-1-3
 2. 6 oz of JRM Mycorrhizal Injectables per 100 gal. of water

WEED CONTROL/TREATMENT

- A. All site locations to receive planting where weeds exist, shall be treated with post-emergent herbicide.
 - 1. Repeat treatment as required to ensure that no weeds are present at the beginning of work on the landscape planting of the Project.
- B. Weeds shall not be present at the date of inspection for Substantial Completion of the Project and at the conclusion of the maintenance and establishment period following acceptance of the Contractor's work.
- C. Post-emergent weed treatment includes:
 - 1. Removal of weeds and other undesirable ground cover vegetation in turf/grass and planting areas shall be accomplished a minimum of 14 days prior to soil preparation for planting operations.
 - 2. Care shall be taken not to affect existing trees, shrubs, and plants on and near the site.
- D. Pre-Emergent Herbicide treatment:
 - 1. Apply per manufacturers distribution rate prior to mulching and directly after mulching.
 - 2. Snapshot, Princep or Specticle are approved Pre-Emergents. Contractor to submit product for approval.

END OF SECTION 32 91 00

SECTION 32 92 00 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Hydromulch Seeding and Soil Supplements
 - 2. Dry Application Seeding.
 - 3. Solid Sod Installation
- B. Related Sections
 - 1. Finish Grading - Section 31 2215
 - 2. Planting - Section 32 9300
 - 3. Landscape Maintenance - Section 32 9400

1.2 QUALITY ASSURANCE

- A. Source:
 - 1. Seed: The Owner's representative shall be furnished a signed copy of statement from vendor, certifying that each container of seed delivered is labeled in accordance with the Federal Seed Act and is at least equal to requirements previously specified. Seed analysis shall be furnished prior to commencement of planting operations. Each lot of seed may be resampled and retested in accordance with latest Rules and Regulations under the Federal Seed Act at the discretion of the Owner's representative. If these tests reveal the seed to be below the specified pure live seed content, the Contractor shall be required to plant additional seed to compensate for the deficiency at no additional cost to the Owner. The State Seed Laboratory will conduct the seed retests. Allowance will be made for the actual pure live seed content of the specified grasses in determining the actual planting rate.
- B. Inspections:
 - 1. Make written request for inspection after seeding operations have been completed. Such inspection is for the purpose of establishing the Maintenance Period.
 - 2. Submit written requests for inspections to the Owner's representative at least 7 days prior to anticipated inspection date.

1.3 SUBMITTALS

- A. Furnish required copies of manufacturers literature, certifications, or laboratory analytical data for the following items:
 - 1. Seed source. (Certification)
 - 2. Fiber mulch. (Laboratory analytical data)
 - 3. Tank mix fertilizer. (Certification or laboratory analytical data)
 - 4. Topdress fertilizer. (Certification)

1.4 MAINTENANCE BY THE CONTRACTOR (refer to section 32 94 00)

1.5 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Owner's representative upon satisfactory completion of all work, but exclusive of re-application under the Guarantee Period. Final Acceptance of lawn or prairie establishment shall be as follows:
 - 1. For Sod: Complete lush cover with no brown sections or cracks showing. Sod shall have established to the extent that satisfactory capillary action between the sod and soil has been established.

2. For Lawn Seed: 95% uniform coverage of grass in excess of 1" height. No bare spots of greater than 2 square feet will be accepted.
3. For Native Seed: 90% coverage of plants in excess of 6" height. No bare spots greater than 2 square feet will be accepted.
4. The Owner's representative and/or Owner shall interpret the above. Upon Final Acceptance, the Owner will assume the responsibility for maintenance of the work.
5. If the seeding season for Native Grass Mix is missed due to the wrong season for proper germination and grow-in, the contractor is required to return to the project site and apply seed the following appropriate season at no additional cost to the owner. **Native seed shall be installed March-June.**

PART 2 - PRODUCTS

2.1 SEED

- A. All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Owner's representative. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable.
- B. The minimum percentage by weight of pure live seed in each lot of seed shall be as follows and seed shall be planted at the rate per acre indicated under pure live seed required per acre.

Kind of Seed	Minimum % Pure Live Seed Required	Pounds Pure Live Seed Required Per Acre
COMMON BERMUDA	95	20

Note: % Pure Live Seed = % Purity X % Germination

- C. Weed seed shall not exceed 10% by weight of the total of pure live seed and other material in the mixture. Johnson grass, nut grass, or other noxious weed seed will not be allowed.
- D. If Native American Seed Mixes seeding seasons are missed the contractor will be required to seed Perennial Rye at a rate of 15 pounds per acre and return the following season to install the specified grass at no cost to the owner.

2.2 FERTILIZER FOR TANK MIX

- A. MicroLife Multi-Purpose 6-2-4, pelleted, uniform in composition, free-flowing, and suitable for application with approved equipment. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name or trademark and warranty of the producer.

2.3 WOOD CELLULOSE FIBER MULCH

- A. Wood Cellulose fiber mulch, for use with the hydraulic application of grass seed and fertilizer, shall consist of specially prepared wood cellulose fiber. It shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like groundcover which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to air dry weight of the fiber, a standard equivalent to 18% moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and be marked by the manufacturer to show the dry weight content.

Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.

2.4 WATER

- A. Drinkable, directly from local utility supply.

2.5 SLURRY MIX COMPONENTS PER ACRE

- A. Wood Cellulose Fiber Mulch 2,000 pounds
- B. Grass Seed (as specified)
- C. Fertilizer (13-13-13) 800 pounds

2.6 SOD

- A. One year old sod, ref. planting schedule for sod selection. Sod shall be dense with the grass having been mowed at 1" height before lifting from field. All grown on fumigated soil. Sod shall be in vigorous condition, dark green in color, free of disease and harmful insects. Do not stack for more than 24 between time of cutting and time of delivery. Owner's representative reserves the right to reject any sod deemed unacceptable for installation.

2.7 TOPDRESS FERTILIZER

- A. (Delayed Application) Complete fertilizer, 50% of the nitrogen shall be derived from natural organic sources or urea-form. Available phosphoric acid shall be from superphosphate, bone, or tankage. Potash shall be derived from muriate of potash containing 60% potash. Apply at rate to achieve 1.5 # N/1000sf.
 - 1. 16% Nitrogen
 - 2. 6% Phosphoric Acid
 - 3. 8% Potash

2.8 TOPDRESS MIX

- A. Topdressing under existing trees shall be:
 - 1. 2/3 Cubic Yard Planting Soil-Ref. 32 9100
 - 2. 1/3 Cubic Yard Sand-Ref. 32 9100

PART 3 - EXECUTION

3.1 HYDROMULCH SEEDING OF BERMUDA GRASS AND PRAIRIE SEED ON PREPARED FINISHED GRADE

- A. Bed Preparation:
 - 1. Ref. Soil Preparation 32 91 00
 - 2. Rake or Harrow 3"-4" deep
- B. Hydroseeding:
 - 1. Immediately after the finished grade has been approved, begin hydroseeding operation to reduce excessive weed growth.
- C. Perimeter Sodding:
 - 1. Install two courses of sod at perimeter of area to receive hydroseeding. Install in compliance with requirements of "SODDING ON PREPARED FINISHED GRADE" requirements below.

- D. Special Mulching Equipment and Procedures:
1. Hydraulic equipment used for the application of fertilizer, seed, and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing up to 40 pounds of fiber plus a combined total of 70 pounds of fertilizer solids for each one 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles, which provide even distribution of the slurry on the slopes to be seeded. The slurry tank shall have a minimum capacity of 800 gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste. The Owner's representative may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.
- E. Mixing:
1. Care shall be taken that the slurry preparation takes place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good re-circulation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp mulch shall be added by the time the tank is two-thirds to three-fourths full. Spraying shall commence immediately when the tank is full. The operator shall spray the area with a uniform, visible coat by using the green color of the wood pulp as a guide.
- F. Application:
1. Obtain approval of hydromulch area preparation from the Owner's representative prior to application.
 2. Operators of hydromulching equipment shall be thoroughly experienced in this type of application. Apply specified slurry mix in a motion to form a uniform mat at specified rate.
 3. Keep hydromulch within areas designated and keep from contact with other plant material.
 4. Slurry mixture which has not been applied within 4 hours of mixing shall not be used and shall be removed from the site.
 5. After application, do not operate equipment over the covered area.
 6. Immediately after application, thoroughly wash off any plant material, planting areas, or paved areas not intended to receive slurry mix. Keep all paved and planting areas clean during maintenance operations.
 7. Refer also to the maintenance portion of this Section.
- G. Unseeded Areas: Reseed unplanted areas with the specified grasses at no additional cost to the Owner.

3.2 DRY APPLICATION SEEDING FOR NATIVE GRASS/BERMUDA GRASS MIXES

- A. Seed Bed Preparation:
1. Ref. Soil Preparation 32 91 00
 2. Rake or Harrow 3"-4" deep
- B. Seeding:
1. Plant seed with a broadcast seeder or a Culti-packer seeder. Plant grass seed no deeper than ¼ inch and the distance between rows 12 inches or less. Distribute seed evenly.

2. Roll the planted seedbed with a Culti-packer immediately after seeding and prior to applying mulch cover.
 3. Seed may be broadcast by hand for small areas or areas inaccessible to seeding equipment, as approved by the Engineer. Areas seeded by hand shall be rolled or lightly compacted, if possible.
- C. Mulching:
1. Spread straw or hay mulch on seeded areas with a slope steeper than 8H:1V immediately after application of seed.
 2. Apply straw or hay mulch at a rate per acre of 2000lbs., to create a uniform mat of coverage a minimum of ½ inch thick to protect the seedbed.
 3. Secure straw or hay mulch with hydromulch or other approved methods.
 - a. Apply a hydromulch, consisting of a homogeneous aqueous mixture of recycled paper fiber, water and tackifier or soil stabilizer, to achieve a rate of 1,000 pounds of paper fiber mulch per acre over the straw mulch. Apply guar gum tackifier at a minimum rate of 50 pounds (dry weight) per acre.
 - b. Application rate for other tackifier or soil stabilizer compounds shall be in accordance with the manufacturer's recommendations and approved by the Engineer.

3.3 SODDING ON PREPARED FINISHED GRADE

- A. Bed Preparation:
1. Ref. Soil Preparation 32 91 00
 2. Immediately after the finished grade has been approved, begin sodding operations to reduce excessive weed growth. If sod bed is dry immediately prior to sod installation, dampen surface with a fine mist of water.
- B. Installation:
1. Lay sod so that adjacent strips butt tightly with no spaces between strips. Lay sod on mounds and slopes with strips parallel to contours. Stagger joints. Sodded areas shall be flush with adjoining seeded areas. At walks and pavements lay one strip of sod parallel to pavement and make cuts at this strip. At back of curb there shall be a double sod strip totaling 36" so that it can be maintained with a 36" wide mower deck.
 2. Tamp and roll sod thoroughly to make contact with sod bed.
 3. Peg sod on slopes three to one or steeper with pegs driven through sod into soil until pegs are flush with turf. Space pegs 18" on center. Pegs shall be 1" square by 6" pine or 6" lengths of lath.
 4. Water sod thoroughly immediately after fertilizing.
 5. Roll sod with 200 lb ballast roller immediately after sod has been installed and watered.

3.4 CLEAN UP

- A. Keep all areas of work clean, neat, and orderly at all times. Keep all paved areas clean during lawn installation operations. Clean up and remove all deleterious materials and debris from the entire work area prior to Final Acceptance to the satisfaction of Owner's representative.

3.5 INSPECTIONS

- A. Make written request for inspection prior to seeding and after areas have been seeded and sodded.
- B. Submit requests for inspections to Owner's representative at least 2 days prior to anticipated inspection date.

END OF SECTION 32 92 00

SECTION 32 93 00 - PLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Tree stabilization.
 - 3. Tree-watering devices.
 - 4. Landscape edgings.
 - 5. Landscape mulches and gravels
- B. Related Requirements:
 - 1. Section 32 9200 "Lawns and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
 - 2. Section 32 9100 "Soil Preparation"

1.2 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
 - 3. Irrigation inspection tube and cap materials.
 - 4. Fertilizer tablets for tree installation
- B. Samples for Verification: For each of the following:
 - 1. Mulch: 1-quart volume of mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 - 2. Planting Soil Mix: 1-quart volume of mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample

shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

3. Weed Control Barrier: 12 by 12 inches.
4. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
5. Tree Staking Materials and Accessories: post, hose, and webbing (sample of each)

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Three years' experience in landscape installation in addition to requirements in Section 01 4000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Interior.
 - c. Landscape Industry Certified Horticultural Technician.
 5. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
 1. Selection of plants shall be made by Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- H. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 2. Do not remove container-grown stock from containers before time of planting.
 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 2. Warranty Periods: From date of Substantial Completion.
 - a. Trees: 1 year.
 - b. Shrubs, Vines, Ornamental Grasses, Ground Covers, Biennials, Perennials, and Other Plants: 1 year
 - c. Sod: 1 year
 - d. Annuals: Three months.
 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

- D. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 FERTILIZERS

- A. Trees: Ref 32 9100 "Soil Preparation" for fertilizer selection
- B. Shrub, groundcover, annuals and perennials: MicroLife all organic fertilizer as supplied by San Jacinto Environmental (713) 957-0909. Apply at mfg. max. recommended rates. Ref. Section 32 9100- "Soil Preparation"

2.3 MULCHES

- A. Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Hardwood mulch
 - 2. Grind: 1.5"x2"max, Double Ground
 - 3. Color: Natural (Brown)
 - 4. Depth: 1.5" min 3.5" maximum
- B. Compost: Ref 32 9100 "Soil Preparation"

2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.
- B. Miriafi 140 NL as manufactured by Nicolon Mirafi Group, Pendergrass, GA, (888) 795-0808 or approved equal.

2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer. Cross reference with 32 9100-Soil Preparation
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

A. Stakes and Guys:

Contractor shall use staking materials necessary to meet requirements of specifications, subject to approval:

1. Tree Stakes: 7' & 8' long steel T-post weighing 1.33 pounds per foot.
2. Paint for Stakes: Pittsburgh Paint No. 515-5 Stonehenge Greige.
3. Tie Webbing: Tree Tie Webbing by AM Leonard-Green
4. Rootball Fixing Sub Surface Anchors: Platipus Anchors RF2P 3-Leg

2.7 LANDSCAPE EDGINGS

A. Steel Edging: Ref. Materials Schedule

2.8 MISCELLANEOUS PRODUCTS

- A. Root Barrier: Black, molded, modular panels manufactured with 50 percent recycled polyethylene plastic with ultraviolet inhibitors, 85 mils thick, with vertical root deflecting ribs protruding 3/4 inch out from panel, and each panel 24 inches wide.
- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Burlap: Non-synthetic, biodegradable.
- D. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- E. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
- F. Mycorrhizal Fungi: Dry, granular inoculants containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Apply fertilizer directly to subgrade before loosening.
 2. Thoroughly blend planting soil off-site before spreading.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

- b. Mix lime with dry soil before mixing fertilizer.
- 3. Spread planting soil to a depth indicated on the Drawings.
 - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at maximum application rate recommended by manufacturer.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 1. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 5. Maintain supervision of excavations during working hours.
 - 6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
 - 7. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Follow Soil Preparation Execution. Ref. 03 9100
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Use Blended Planting Soil for backfill. Follow Soil Preparation Specification. Ref. 329100
 - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Follow Soil Preparation Specification. Ref. 039100 for fertilization.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set balled and potted, and container-grown stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Use Blended Planting Soil for backfill. Follow Soil Preparation Specification. Ref. 329100
 - 2. Carefully remove root ball from container without damaging root ball or plant.
 - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 4. Follow Soil Preparation Specification. Ref. 039100 for fertilization.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.7 TREE STAKING

- A. Staking of trees is to be used by the Contractor, who will be responsible for material remaining plumb and straight for all given conditions through the guarantee period. Tree support shall be done as outlined on the following tables.
- B. Staking shall be completed immediately after planting. Plants shall stand plumb after staking.
- C. Stake all trees in accordance with the following table:

Tree	Stakes	Stake Size
15-45 Gal. and B&B under 3"	2	6 ft Post
65 Gal. and B&B 3"& larger	3	7 ft Post
- D. Locate first stake on prevailing windward side of tree and as close to the main trunk as is practical, avoiding root injury. Stakes shall be driven at least 18" into firm ground.
- E. Tie tree to stake using approved tree tie. Tie shall be located midway within tree crown or at a location approximately 2/3 of the overall height of the tree. Locate tie just above major side branch in order to deter slippage of tie.
- F. Locate second stake opposite first. Secure with one tie opposite upper tie at first stake.
- G. Auxiliary stem stakes shipped with trees shall be secured as above after shipping.

3.8 ROOT-BARRIER INSTALLATION

- A. Install root barrier where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways unless otherwise shown on Drawings. Deep Root 24-2 or approved eq.
- B. Align root barrier vertically and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.
- C. Install root barrier continuously for a distance of 60 inches in each direction from the tree trunk, for a total distance of 10 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier.
 - 1. Position top of root barrier flush with finish grade.
 - 2. Overlap root barrier a minimum of 12 inches at joints.
 - 3. Do not distort or bend root barrier during construction activities.
 - 4. Do not install root barrier surrounding the root ball of tree.

3.9 GROUND COVER AND PERRENIAL PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on the Drawings
- B. Use planting soil for backfill. Follow soil preparation execution. Re. 329100
- C. Dig holes large enough to allow spreading of roots.

- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Tree-like Shrubs in Turf Areas: As indicated on the Drawings or 3" depth
 - 2. Organic Mulch in Planting Areas: As indicated on the Drawings or 3" depth
 - 3. Mineral Mulch in Planting Areas: As indicated on the Drawings

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Reference the Maintenance Specification 329400 for further information.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas. Ref. 32 9100-Soil Preparation for clarifications.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations. Ref. 32 9100-Soil Preparation for clarifications.

3.13 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 93 00

SECTION 32 94 00 - LANDSCAPE GROUNDS MAINTENANCE FOR NINETY (90) DAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Drawings, Division 0 and Division 1 apply to work under this Section.

1.2 SCOPE OF WORK:

A. Work included in Base Bid:

1. Monitoring adjustment and minor repair of the landscape irrigation system.
2. Mowing, edging and trimming of lawn areas.
3. Mowing of Love Grass and Native Grass Plantings
3. Pruning and trimming of plant materials.
4. Weed, cultivating and cleaning of planting beds, turf areas, and Native grass areas..
5. General site clean up; removal of trash and products of maintenance.
6. Applications of fertilizers, ant control, insecticides and herbicides.
7. Pruning and trimming of trees.
8. Mulching trees, shrubs, groundcovers and seasonal color.
9. Extra services as needed.

B. Work Not Included in Base Bid: (Extra Service)

1. Street cleaning - other than that required as a result of maintenance operations.
2. Replacement of plant material - other than that required under the one year warranty requirement.
3. Compost amendment application
4. Aerating lawn areas.
5. Overseeding with cool-season grasses.
6. Application of pre/post emergents.
7. Additional clean-up and/or plant material replacement relating to natural weather events including hurricanes, tornadoes, severe thunderstorms, major rain events causing flooding, freezing temperatures, ice/ice storms, extended periods of draught and snow.

1.3 EXTRA SERVICES:

The intent of the ninety day maintenance period is to provide a comprehensive maintenance program to include all required services, except those services specifically excluded, to perform the work for the stated time period.

1. All services not included in the list of Base Bid items shall be considered 'extra services' and will be charged for separately according to the nature of the item of work. The consent and authorization of the Owner's representative or their authorized representative must be obtained prior to the performance or installation of such "extra services" items and prior to purchase of any chargeable materials.
2. Such work may include replacement of dead plant materials other than what is already covered under the warranty period, major repairs of irrigation system, by-products of vandalism or other contracts or other site related work.

3. Application of pre/post emergents.
4. Authorized extra services work must be summarized weekly and submitted with receipts to the Owner's representative.
5. The Owner's representative is not bound by the specifications or contract to utilize the landscape maintenance contractor in the performance of "extra services" work.
6. The landscape maintenance contractor shall coordinate his activities with other contractors on the site so as to not hinder the performance of any work.
6. Authorized charges for extra work will be paid per the General Conditions of the Contract.

1.4 SUBSTITUTIONS:

- A. Specific reference to manufacturer's names and products specified in this Section are used as standards, but this implies no right to substitute other material or methods without written approval of the Owner's representative. Such permission must be secured without additional cost to Owner's representative.
- B. Installation of any approved substitution is Contractor's responsibility. Any changes required for installation of any approved substitution must be made to the satisfaction of and without additional cost to Owner's representative.

1.5 INTENT OF THE MAINTENANCE PROGRAM:

It is the intent of the maintenance program is to provide the Owner's representative with a project site that is attractive in appearance and keep all plant materials and lawns in a healthy and vigorous condition.

1.6 THE CONTRACT:

This Maintenance Contract is a period ninety days. The Contract can be terminated with cause.

1.7 CONTRACTORS PERFORMANCE:

The Contractor shall perform all work required once per week or as often as necessary to fulfill the spirit and intent of the Contract. The workmen shall be dressed in company uniforms and all required PPE (Personal Protective Equipment), and neat in appearance, perform their work in a professional manner, keep noise to a minimum and stage their work from a location on the site out of the way of the mainstream of the users. In general, the Contractor's presence on the site shall be as inconspicuous as possible.

1.8 COMMENCEMENT OF THE MAINTENANCE PERIOD:

This maintenance period shall become effective at the date of Substantial Completion.

1.9 NEGLECT AND VANDALISM:

1. Turf, shrubs, trees or plants that are damaged or killed due to contractors operations, negligence or chemicals shall be replaced at no expense to the Owner's representative. If plant damage or death is caused by conditions beyond the contractor's control, replacement shall be at the Owner's representative's expense.
2. Sprinklers or structures that are damaged due to the contractor's operations must be replaced by the contractor promptly. Likewise, damage to the irrigation system by others shall be corrected immediately by the contractor, at the Owner's representative's expense.
3. All water damage, either natural or man-made, resulting from contractor's neglect shall be corrected at the contractor's expense.
4. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the contractor shall be corrected by the contractor at the Owner's expense upon receipt of written authorization to proceed.

1.12 EMERGENCIES:

1. The Contractor shall answer emergency or complaint calls within twelve (12) hours and corrective action shall be complete within twenty-four (24) hours.
2. The Contractor shall answer emergency calls regarding the Landscape Irrigation system failure or need of repair, and take corrective action within eight (8) hours. Such work, unless caused due to neglect on the part of the Landscape Maintenance Contractor, shall be considered "Extra Services".

1.13 JOB CONDITIONS:

- A. Contractor shall be familiar with all site conditions.

1.14 RESTRICTIONS:

- A. Do not use growth regulators or growth retardants or any chemicals that will have adverse effects on the organic fertilizers and soil conditioners utilized for this project.

PART 2 - PRODUCTS AND MACHINERY

2.1 MATERIALS:

Materials listed under this Section are expressly requested for use and does not prohibit or restrict the Contractor from providing other materials not listed in order to complete the work required herein.

1. Pre-Emergence Weed Control: Shall be Surflan A.S., Atrazine 4L or approved equal.
2. Post-Emergence Weed Control: Shall be Trimec Lawn Weed Killer, Sedge Hammer, Vantage, Image or approved equal.
3. Sufactant: Spreader Sticker shall be used with both pre and post emergence herbicides.
3. Herbicide: Shall be "Round Up", by Monsanto, St. Louis, Missouri.

4. Insecticide: Shall be "Astro Insecticide" as manufactured by FMC Corporation, Agricultural Products Group, 1735 Market Street, Philadelphia, PA 19103 (800.321.1362) or approved equal.
5. Fire Ant Control: Ortho Orthene Fire Ant Killer.
6. Compost: Made from recycled natural materials screened to 1" minus (for soil additive). On the Solvita compost maturity test score, must score a value of 5 or higher for tilling into the soil and be a minimum of 6 months old and fully composted. Supplied by Nature's Way Resources, Inc., Conroe, Texas or approved equal.
7. Fertilizer: FERTILIZERS AND NUTRIENT AMENDMENTS:
 - A. Fertilizer: MicroLife Hybrid 20-0-5, MicroLife Ultimate 6-2-4, and MicroLife Humates Plus 0-0-4 as supplied by San Jacinto Environmental Supplies, Houston, Texas or other approved equal supplier.
 - B. Contractor shall keep all empty bags with certificates intact and submit them to the Owner's representative.
 1. Submission of empty fertilizer bags is required to verify operation has been performed as specified.
 - C. Humate Soil Conditioner: Vigoro modified humate, Earthgreen Menefee Humate, Humate International AG 16-35 or approved equal.
 - D. Aerated Compost Tea: Natures Own or approved equal.
8. Tree Deep Feeding Fertilizer: Shall be Aerated Compost Tea with mycorrhizal fungi manufactured by Natures Own, MicroGrow or approved equal
9. Fungicide: Shall be "Systemic Fungicide" with Benomyl by Greenlight Products, San Antonio, Texas 78217, and/or Cleary Chemical 3336 WP "Turf and Ornamental Fungicide.
10. Fertilizer for annuals/perennials:

Nelson ColorStar Plus 19-13-6 with Fungicide

Foliar spray Maximum Blooms 3-8-3 Organic liquid color fertilizer
11. Soil Drenching Material: Shall be "Sub Due 2E", by the Agricultural Division of Ciba-Geigy Corporation, Greensboro, North Carolina 27409.
12. Mulch: Shall be equal to that already in use at the site. Shredded hardwood bark for groundcover areas.
13. Tree Stakes and Guys: Shall match those in use at the site.

2.2 MACHINERY:

Machinery requirements listed under this Section are not intended to be restrictions of specific manufacturers or models unless so stated. Specific mention of manufacturers is intended as a guide to illustrate the final product of maintenance operations desired.

1. Lawn Mowers: Shall be of the rotary type in good working order, finely tuned to protect the lawn from excessive exhaust fumes. Blades shall be sharp to reduce shredding of the cut grass blades.
2. Lawn Edgers: Shall be of a rigid or flexible blade type that will produce a fine clean edge where lawns meet walkways, pavements or curbs.
3. Fertilizer Spreaders: Cyclone type spreader or equal. No visible underlapping of applications will be permitted.
4. Deep Root Feeder: Shall be the Ross type by Ross Daniels, Incorporated, Des Moines, Iowa 50265.
5. Pruning Tools: Shall be maintained in good working order, cutting edges shall be sharp. Disinfect all tools when used for the removal of diseased limbs.

PART 3 - EXECUTION

3.1 LANDSCAPE IRRIGATION SYSTEM:

The Contractor shall monitor and program the automatic controlling devices to proceed optimum moisture levels in all planted areas.

1. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am) unless otherwise instructed by the Owner's representative, except during visits of grounds maintenance personnel; during such visits the irrigation system may be operated as desired by those personnel.
2. Do not program controllers operating on the same water meter to water during the same time period so as to prevent over-draft of water meters. Do not switch controller to "off" at any time, except as required for testing and for maintenance operations.
3. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. Monitor and inspect sprinklers once a month or upon request of the Owner's representative. This check shall include visual "inspection" of all accessible components of the irrigation system including but not limited to controllers, remote control valves, quick couplers and heads.
4. Adjust sprinklers to avoid damage to automobiles, signs and also adjust heads to keep water off the street and sidewalks. Make repairs and alterations to the sprinkling system and water lines. All sprinklers repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.
5. Minor repairs: Contractor shall make necessary repairs under \$300.00 without Owner's representative's approval to maintain operation of the system.
6. Replacement materials throughout the system shall be as specified in Section 02810.

3.2 TREES MAINTENANCE:

- A. Contractor shall maintain staking and guying of trees at all times and shall be responsible for any damage to trees or plant materials caused by chafing or breakage of foliage or limbs coming in contact with stakes or ties. Replace broken plant stakes and ties and bent stakes as needed. If ties are too tight, they must be replaced or adjusted. If stakes are not needed, remove.
- B. Trees that may require guys, stakes or special care during the winter winds and rains shall receive the required care prior to the time of rains and high winds to insure that no damage results to the plant material.
- C. All suckers shall be continually removed from trees.

3.3 SEASONAL AND PERENNIAL FLOWERS:

- A. The maintenance contractor shall continually maintain seasonal flower beds in all contract areas.
- B. Complete weeding, trimming, edging, and cultivation of all flower beds as required to keep the beds free of weeds, to promote growth and maintain neat, orderly appearance. As flowers cover open soil, cultivating shall be discontinued.
- C. Maintenance shall include:
 - 1. Pinching of blooms and pruning of dead or damaged foliage.
 - 2. Fertilize in alternate months with organic fertilizer. (RE: PART 2)
 - 3. Apply supplemental organic fertilizer to keep each type of seasonal flower performing at its optimum level.
 - 4. Spraying or dusting for disease or insect control as a preventive or corrective measure.
 - 5. Seasonal Color Change out: seasonal color change out after the initial planting (Extra Service) by the installing contractor.
- D. Fertilizer for annuals/perennials: Add ColorStar Plus 19-13-6 with Fungicide at the manufacturers recommended rate and feeding schedule. Foliar spray Maximum Blooms 3-8-3 Organic liquid color fertilizer (6 ounces per 1000 sq ft) & Garlic Oil (1 ounce per 1000 sq ft) mixed together with water and sprayed every 30 days.

3.4 HEDGE MAINTENANCE:

- A. Edge, weed, fertilize and cultivate all hedge beds in accordance with Schedule.
- B. Pruning of shrubs should create a uniformly dense plant, trapezoid in shape. Height as approved by Owner's representative. Selectively thin and tip back annually. Prune to enhance natural branching effect of plants. Do not change shape of shrubs by pruning.

3.5 GROUND COVER BEDS:

- A. Complete weeding, trimming, edging, and cultivating of all groundcover as required to keep the beds free of weeds, to promote growth and maintain neat, orderly appearance. As groundcovers cover open soil, cultivating shall be discontinued.
- B. Groundcover beds bordering on paved surfaces must be edged as needed to retain a neat edge. Do not trim vertically so as to expose stems and thatch.
- C. Fertilize all groundcovers with complete commercial fertilizer four times per year. (Extra Service)
- D. Replant all damaged or thin areas in groundcover beds at direction of the Owner's representative, at proper spacing.
- E. Slopes of 2:1 ratio, or steeper, shall not be cultivated due to erosion nuisance, unless otherwise instructed to cultivate by the Owner's representative.

3.6 TURF MAINTENANCE:

- A. Mowing: During periods of mild weather, mow at one and one-half (1 1/2") inches but during hot weather, the cut should be not lower than two (2") inches from the soil. Regular weekly mowing is required. Never scalp the lawn or cut more than one half the existing top growth in one mowing. Remove or catch the clippings, never allowing clippings to remain on lawn surface more than four (4) hours.

Allow grass to grow up to but not over sprinkler heads. Trim grass around heads with a circular sprinkler head trimmer. DO NOT USE LINE TRIM AROUND SPRINKLER HEADS.

- B. Watering: Provide a regular, deep watering program. The established turf should not be kept wet but should dry out somewhat between waterings. A twice weekly watering is good under regular conditions, but if it is hot or windy, water more often. In very hot weather, a fast watering with fine spray will cool the turf zone and can supplement the regular, deeper watering program. In shaded areas caused by trees or shrubs, water more frequently because of the competition for soil moisture. If lawn wilts (shows grey-brown) water more frequently.

- C. Lawn Fertilizer: Analysis based upon soil sample.

March 1	MicroLife Hybird 20-0-5 applied at manufacturer's maximum recommended rate.
May 25	MicroLife Humates Plus 0-0-4 at manufacturer's maximum recommended rate.
July 18	Same as the March application.
October 11	MicroLife (6-2-4) at manufacturer's maximum recommended rate.

- D. Weed Control: Contractor shall use extreme care in the use of chemicals for weed control. Before such applications are made, the turf should be well established and in a vigorous condition. Broadleaf weeds such as malva, dandelion and plantain can be controlled with

applications of selective and recommended herbicides. Always follow label directions fully and carefully; wash sprayer carefully after using herbicides.

- E. Insects: Control insects with regular applications of commercial insecticides at the manufacturer's recommended rate. Spray for insects once a month from mid-spring through summer as a preventative measure.
- F. Diseases: When they first appear, spray for diseases with an approved commercial fungicide strictly according to the manufacturer's recommendations.

3.7 NATIVE GRASSES MAINTENANCE

- A. Native grass mixes – Twice annually on or about June 1st and January 1st
- B. Above grasses shall be mowed to a 6" height.

3.8 CONTROL OF NOXIOUS WEEDS (Johnson Grass, Nut Grass, Poison Ivy, and other Noxious Weeds.)

- A. Noxious weeds shall be killed by using "Round Up" or other spray as approved by Owner's representative. Spray only foliage of grass to be eradicated, as this spray will kill any plant that it contacts.
- B. Irrigation to sprayed area should remain "off" for a period of three days following spray application. Repeat spray as required to kill completely.
- C. Apply pre/post-emergent weed killer as per manufacturer's recommendation as required by the "Schedule" and approved by Client prior to application.
- C. Weeds 30" or taller shall be removed/eradicated in Native Grass zones.

3.9 USE OF HERBICIDES, INSECTICIDES, AND STERILANTS:

- A. The Contractor is hereby granted permission to use such herbicides, insecticides, and sterilants as it may find necessary and advantageous in its grounds maintenance activities. Herbicides, insecticides, and sterilants, must be used responsibly and in conformance with Federal, State, and Local laws and regulations. The Contractor assumes all liability for damage and/or injury resulting from accident or misuse of these products and/or equipment. The Owner's representative retains the right to prohibit the use of any herbicide, insecticide, and sterilant that he may judge to be undesirable for any reason.
- B. Products leaving an undesirable residue or odor (i.e., weed oil) shall not be used.
- C. The Owner's representative shall be notified prior to application and advised of any danger associated with the use of these products (i.e., to avoid personal contact with sprayed areas, etc.).
- D. Apply insecticides as needed to protect all plant materials from damage. The insect control program shall include slugs and snails and advance preventive spraying for twig borers. The Contractor shall be responsible for the choosing of chemicals and insecticides he uses and shall be accountable for any misuse of same.

- E. Apply the proper fungicide, herbicide and pesticides for the control of pests, weeds and plant diseases or treat cuts on exposed surfaces of trees or shrubs for disease and pest control on turf, plants and trees.

3.10 GENERAL CLEAN UP:

- A. The Contractor shall dispose of all waste materials or refuse from his operations legally off the property except where agreement is reached with the Owner's representative.
- B. All plant growth shall be prevented in any cracks in walks or within paved areas.
- C. Leaves, papers, grass clippings or other debris shall be removed at least weekly or at each visit from all areas.
- D. Trash receptacles shall be checked regularly and emptied, and trash removed from the site frequently enough so that trash never overflows the receptacles. Trash receptacles shall be lined with black plastic bags which shall be emptied and removed from the site daily.

PART 4 - SCHEDULE

4.1 SCHEDULE:

The Schedule as included herein shall govern the work. Should the Contractor require an alteration of the Schedule, contact the Owner's representative.

JANUARY: WEEKS 1, 2, 3, 4

TURF

The turf shall be watered as needed. Turf shall be raked during the latter part of the month, to remove thatch. Mow turf for the first time in week 4.

TREES, SHRUBS, AND VINES

Trees shall be pruned except flowering trees and flowering shrubs which shall be pruned after flowering. Do not change shape of tree, prune to enhance shape. Pre-emergent herbicides shall be applied if approved by Client. Weed beds as required.

FEBRUARY: WEEKS 1, 2, 3, 4

TURF

The turf shall be watered as needed. Turf shall be raked during the latter part of the month, to remove thatch. Mow turf weeks 2 and 4.

TREES, SHRUBS, AND VINES

Continue pruning trees. Apply tree fertilizer to established trees. Deep root feeding is method to use during this period. Iron and other elements shall be applied if needed. Fertilize acid loving plants as called out under "Material Used". Do not fertilize flowering shrubs until blooming is completed.

MARCH: WEEKS 1,2

TURF

Turf shall be mowed in week two. Mowing shall not remove more than one-quarter (1/4") inch off existing height. First application of fertilizer (Microlife Hybrid 20-0-5) shall be applied at manufacturer's maximum recommended rate. Water thoroughly after applying fertilizer. Mow first; then fertilize.

TREES, SHRUBS, AND VINES

Check Plants for adequate watering to prevent any winter damage. Water if necessary. Prune dead wood as required. Continue to weed beds.

Mulch shall be placed in all beds, a two (2") inch to three (3") inch layer over existing mulch if mulch is not adequate. Dead vines should be removed. Flowering plants should be fertilized only after blooming.

MARCH: WEEKS 3, 4

TURF

Mow as required; still only one-quarter (1/4") inch off existing growth. Water as required. Weed control should be continued. Replace any winter damaged sod at this time.

TREES, SHRUBS, AND VINES

Inspect evergreens for insects and diseases, spray as required. Spray for borers. Continue to weed beds. Fertilize trees and flowering shrubs if they have buds. Application should be 10-8-4 at a rate of ten (10) pounds per 1,000 square feet. Acid loving plants should be given special attention as called out in "Material Used".

APRIL: WEEKS 1, 2, 3, 4

TURF

Mowing should be continued; begin cutting one and one-half (1 1/2") inches to two (2") inches above grade. Water as required.

TREES, SHRUBS, AND VINES

Flowering plants should be through flowering and ready to be pruned and fertilized, if not already completed. Prune remaining dead wood from trees, shrubs, and vines, retaining natural shape. Continually remove all suckers on base of trees.

MAY: WEEKS 1, 2

TURF

Mowing shall continue once a week. During this period, it is important to note the soil moisture. Grasses may have been actively growing for about two and one-half (2 1/2) months, and need to be watered thoroughly.

TREES, SHRUBS, AND VINES

Inspect evergreens for mites and borers and spray as required. Inspect plants for scale insects and spray as required. Inspect flowering trees for powdery mildew and apply fungicide as required. Apply herbicide to shrub beds as required, using the same materials as in early spring. Weed beds as required. Water established trees at a rate of two (2") inches per week.

MAY: WEEKS 3, 4

TURF

Mow as required. Second application of fertilizer (Microlife Humates 0-0-4) shall be applied at manufacturer's maximum recommended rate. Water thoroughly after applying fertilizer. Mow first; then fertilize. Particular attention shall be directed to the amount of water applied to turf.

TREES, SHRUBS, AND VINES

Continue to check plants for pests and control as required. Water any established plants as needed. Pruning shall cease until Fall. Apply fertilizer to acid loving plants again.

JUNE: WEEKS 1, 2, 3, 4

Mulching trees, shrubs, groundcovers and seasonal color.

NATIVE GRASSES

Native grasses and love grass shall be mowed.

TURF

Mowing shall continue once per week. As the temperature rises, the mower should be raised one-half (1/2") inch to one (1") inch higher to maintain a good thick stand of grass. Inspect lawn for disease and inspect pests; apply fungicide only if necessary. Be alert for brown patch, Bermuda decline and chinch bugs in Bermuda sod. Watch Bermuda for bare spots and underwatered areas.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Do not fertilize any wood plants until cooler weather. Continue to check plants for pests and control as required. Weed beds as required.

JULY: WEEKS 1, 2, 3, 4

TURF

Mow weekly, maintain previous months height. Avoid watering in the middle of the day. Check turf for disease again, especially chinch bugs. Third application of fertilizer (Microlife Hybrid 20-0-5) should be applied at manufacturer's maximum recommended rate. Apply recommended controls as necessary.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Do not fertilize any woody plants until cooler weather. Continue to check plants for pests and control as required. Weed beds as required.

AUGUST: WEEKS 1, 2, 3, 4

TURF

Mow weekly. Continue to irrigate as needed to keep turf from being stressed by lack of water. Inspect lawn for diseases. Apply necessary chemicals if needed; use caution.

TREES, SHRUBS, AND VINES

Continue to check trees, shrubs, and vines for adequate moisture around rootballs. No pruning shall be done during this period. Check all trees, shrubs, and vines for possible disease and insects, spray if necessary. Second application of fertilizer should be spread at manufacturer's maximum recommended rate.

SEPTEMBER: WEEKS 1, 2

TURF

Mow weekly. At this time lower mower to one and one-quarter (1 1/4") inches to one and one-half (1 1/2") inches. Irrigate as needed.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Root feed trees again. Acid type fertilizer and iron should be applied to trees, shrubs, and vines.

SEPTEMBER: WEEKS 3, 4

TURF

Mow weekly. Watch turf for diseases, apply chemicals as required.

TREES, SHRUBS, AND VINES

Maintain adequate soil moisture for all trees, shrubs, and vines. Prune only if necessary. Continue to check for any pests or disease, apply chemicals as required.

OCTOBER: WEEKS 1, 2, 3, 4

TURF

Mow weeks 1, 2 and 4. Watering can be reduced at this time. Continue to check for diseases. Fourth application of fertilizer (MicroLife 6-2-4) shall be applied at manufacturer's maximum recommended rate. Mow first; then fertilize. Water thoroughly after applying fertilizer. Turf should be thick and healthy for winter months. Overseed with annual rye grass at the rate of four (4) pounds per 1,000 square feet (only if requested by the Owner).

TREES, SHRUBS, AND VINES

Check trees for proper fertilization. Apply necessary elements, if inadequate. Pruning can be started lightly at this time. Weed beds as required. A two (2") inch layer of mulch shall be added on top of existing mulch.

NOVEMBER: WEEKS 1, 2, 3, 4

TURF

Mow weeks 2 and 4. Water less at this time.

TREES, SHRUBS, AND VINES

Examine plants for pests and spray as required. Do not use pesticides unless necessary. Weed beds as required.

DECEMBER: WEEKS 1, 2, 3, 4

NATIVE GRASSES

Native grasses and love grass shall be mowed.

TURF

Last mowing shall be performed during first 2nd week of month. Rake leaves as required.

TREES, SHRUBS, AND VINES

Remove leaves from beds. Weed beds as required. Check plants for diseases, spray as required.

END OF SECTION 32 94 00

SECTION 32 94 43 - TREE GRATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast metal tree grates.
 - 2. Metal frames and accessories.

1.2 DEFINITIONS

- A. ADA: Americans with Disabilities Act.

1.3 REFERENCE STANDARDS

- A. General: Use most current standard, unless otherwise indicated by specific date.
- B. ASTM International:
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A48 - Standard Specification for Grey Iron Castings.
 - 3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A536 - Standard Specification for Ductile Iron Castings
 - 6. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings.
 - 7. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 8. ASTM E303 - Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
 - 2. AWS D1.2 - Structural Welding Code - Aluminum.
 - 3. AWS D1.6 - Structural Welding Code - Stainless Steel.
- D. California Department of Health Services:
 - 1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- E. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC SP 10 - Near-White Blast Cleaning.

F. Military Standardization Documents:

1. MIL A-8625 - Anodic Coatings for Aluminum and Aluminum Alloys.
2. MIL PRF-24712A - Coatings, Powder.

1.4 COORDINATION

A. Coordinate Work of this Section with:

1. Placement of frames.
2. Size of cast-in-place curb and pavement openings.
3. Placement of in-ground light fixtures.
4. Plant irrigation systems and controls.

1.5 SUBMITTALS

A. Product Data: Indicate compliance with applicable Reference Standards.

B. Shop Drawings: Indicate details of each type and size of grate, component supports, anchorages, openings, perimeter construction details, and tolerances.

1. Where custom design or layout has been furnished by the Design Professional, submit CAD file, in addition to other Drawings, to indicate compliance with design intent.
2. Where intent of Design Professional cannot be met due to size, material, or casting limitations, clearly indicate exceptions on Submittal documents.

C. Samples: Submit [two] 2 cast metal samples, 12 by 12 inch in size, illustrating finish, color, and texture.

1.6 QUALIFICATIONS

A. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.

1.7 WARRANTY

A. Provide manufacturer's standard one-year 1-year warranty on products and assemblies.

1.8 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements of existing trees or obstructions affecting tree grates prior to fabrication. Indicate field measurements provided by General Contractor or other parties on Shop Drawings

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. General: Conform to local code(s) as indicated on Drawings for applicable loads.
 - 1. Except where required by Authority Having Jurisdiction (AHJ), provide tree grates for pedestrian live load only, 100 lbs./sq. ft.

2.2 TREE GRATES

- A. Manufacturers:
 - 1. Urban Accessories, Contact Spruce&Gander @ 760.690.4083
 - 2. Substitutions: Section 016000 - Product Requirements.

2.3 SUSTAINABILITY CHARACTERISTICS

- A. Material and Resource Characteristics:
 - 1. Recycled Content Materials: Furnish materials with minimum of 80 percent recycled metal content.
- B. Indoor Environmental Quality Characteristics:
 - 1. Paints and Coatings: Maximum volatile organic compound content according to product and testing requirements of CA/DHS/EHLB/R-174.

2.4 GRATE MATERIALS

- A. Cast Iron: ASTM A48, CL 30 or better.
- B. Cast Ductile Iron: ASTM A536; alloy 65-45-12
- C. Cast Aluminum: ASTM B26; alloy #535, marine grade.
- D. Cast Bronze: ASTM B584 silicone bronze alloy C87500.

2.5 TREE GRATES

- A. Size: As indicated on Drawings.
- B. Basis of Design Pattern: To be Selected
- C. Number of Sections per Set: As indicated on Drawings.
- D. Tree Opening: As indicated on Drawings.
 - 1. Expanded Tree Opening: Fabricate round openings with break-out rings to allow tree growth up to 4-inches.

- E. Accessory Openings: Number and locations as indicated on Drawings.
- F. Frames:
 - 1. Mild Steel: ASTM A36, raw/unfinished.
 - 2. Welding Materials: AWS D1.1, type as required for materials being welded.
 - 3. Not required.

2.6 FABRICATION

- A. Fabricate tree grates to accommodate design loads and to sizes indicated.
- B. Fabricate support framing for openings as required. Coordinate locations with fixtures, controls, and penetrations as indicated on Drawings.
- C. Fabricate grates to comply with ADA for maximum opening size, offset of surfaces, and slip resistance. Grates shall have a minimum slip resistance (Pendulum Test Value) of 5.5 or better, per ASTM E303.
 - 1. Provide grates with enhanced heel-proof design, with no opening wider than 1/4-inch.
- D. Removable Panels: With vandal-resistant fastening hardware, recessed finger lift rings and handles.

2.7 GRATE FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Cast Iron:
 - 1. Baked-on oil finish.

2.8 ACCESSORIES

- A. Vandal Resistant Bolts: Stainless steel, 1/4 x 20 fasteners; minimum 2 per casting. Prefabricate frames with fasteners where shown on Shop Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that overall opening sizes and dimensional tolerances are acceptable.
- B. Verify that fixtures placed by other trades are completed, and that openings and penetrations are accurately positioned.
- C. Verify that planting and irrigation work is complete, including removal of excess soil material and trash from tree grate opening.

3.2 INSTALLATION

- A. For cast-in-place frames, furnish to entity responsible for adjacent curbs or pavements.
- B. Ensure trees are planted with top of root ball 6 inches below bottom of support framing to mitigate root ball heaving of grate as tree grows.
- C. For field-anchored frames, anchor by expansion bolts to prepared openings using anchors of type and number recommended by manufacturer.
- D. Ensure that top of frame and tree grate is no greater than 1/8-inch higher or lower than adjacent pavement surfaces.
- E. Place tree grates securely in prepared openings, with no warping or slippage.
- F. Secure where indicated, or as needed to prevent movement. Allow for maintenance removal.

3.3 TOLERANCES

- A. Maximum Space Between Adjacent Sections: 1/4-inch.
- B. Maximum Variation from Top Surface Plane of Adjacent Sections: 1/8-inch.

3.4 PROTECTION AND CLEANING

- A. Protect completed tree grates until time of Substantial Completion.
- B. Clean damaged coatings according to manufacturer recommendations.
- C. After frames are installed, but prior to grate installation, keep soil around trees clear from debris, runoff, or anything that will inhibit proper development and growth of the tree.

END OF SECTION 32 94 43

SECTION #33 05 00 – COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping joining materials.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Sleeves.
 - 5. Identification devices.
 - 6. Grout.
 - 7. Flowable fill.
 - 8. Piped utility demolition.
 - 9. Piping system common requirements.
 - 10. Equipment installation common requirements.
 - 11. Painting.
 - 12. Concrete bases.
 - 13. Metal supports and anchorages.

1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- C. ABS: Acrylonitrile-butadiene-styrene plastic.
- D. CPVC: Chlorinated polyvinyl chloride plastic.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Dielectric fittings.
 - 2. Identification devices.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.
- C. Coordinate size and location of concrete bases.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8-inch-thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
 - 5. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

- A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
- B. Transition Couplings NPS 1-1/2 (DN 40) and Smaller:
 - 1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
 - 2. Aboveground Piping: Specified piping system fitting.
- C. AWWA Transition Couplings NPS 2 (DN 50) and Larger:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements.
 3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
- D. Plastic-to-Metal Transition Fittings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements.
 3. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.
- E. Plastic-to-Metal Transition Unions:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements.
 3. Description: MSS SP-107, PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.
- F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements.
 3. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

- A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements.
 3. Description: Factory fabricated, union, NPS 2 (DN 50) and smaller.
 - a. Pressure Rating: 150 psig minimum at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.
- C. Dielectric Flanges:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements.
 3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) and larger.
 - a. Pressure Rating: 150 psig minimum.

- b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements.
 - 3. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 (DN 65) and larger.
 - a. Pressure Rating: 150 psig minimum.
 - b. Gasket: Neoprene or phenolic.
 - c. Bolt Sleeves: Phenolic or polyethylene.
 - d. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements.
 - 3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 (DN 80) and smaller.
 - a. Pressure Rating: 300 psig at 225 deg F.
 - b. End Connections: Threaded.
- F. Dielectric Nipples:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements.
 - 3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
 - a. Pressure Rating: [300 psig (2070 kPa) at 225 deg F (107 deg C)] <Insert pressure and temperature>.
 - b. End Connections: Threaded or grooved.

2.4 SLEEVES

- A. Mechanical sleeve seals for pipe penetrations are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- B. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
- D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

- A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Installer's option.

- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - 2. Location: Accessible and visible.
- C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.
 - 1. Material: Fiberboard, Brass.
 - 2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.
- F. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.
- G. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.
- H. Lettering: Manufacturer's standard preprinted captions as selected by Architect.
- I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 - 1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.
- J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.
 - 1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 - 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- K. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch- thick, [polished brass] [or] [aluminum].
 - 2. Material: 0.0375-inch- thick stainless steel.
 - 3. Material: 3/32-inch- thick plastic laminate with 2 black surfaces and a white inner layer.
 - 4. Material: Valve manufacturer's standard solid plastic.
 - 5. Size: 1-1/2 inches in diameter, unless otherwise indicated.
 - 6. Shape: As indicated for each piping system.
- L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 - 1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 - 2. Thickness: 1/16 inch unless otherwise indicated.

3. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
 1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Brown: Energy reclamation equipment and components.
 4. Blue: Equipment and components that do not meet criteria above.
 5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
 6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
 1. Size: 3-1/4 by 5-5/8 inches.
 2. Fasteners: Brass grommets and wire.
 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
- P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
 1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

- A. Description: Low-strength-concrete, flowable-slurry mix.
 1. Cement: ASTM C 150, Type I, portland.
 2. Density: 115- to 145-lb/cu. ft.
 3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
 4. Aggregates: ASTM C 33, natural sand, fine.
 5. Admixture: ASTM C 618, fly-ash mineral.
 6. Water: Comply with ASTM C 94/C 94M.
 7. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Refer to Section 024119 "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

- A. Dry Piping Systems: Connect piping of dissimilar metals with the following:
 - 1. NPS 2 and Smaller: Dielectric unions.
 - 2. NPS 2-1/2 to NPS 12: Dielectric flanges.
- B. Wet Piping Systems: Connect piping of dissimilar metals with the following:
 - 1. NPS 2 and Smaller: Dielectric.
 - 2. NPS 2-1/2 to NPS 4: Dielectric nipples.
 - 3. NPS 2-1/2 to NPS 8: Dielectric nipples.
 - 4. NPS 10 and NPS 12: Dielectric flange kits.

3.3 PIPING INSTALLATION

- A. Install piping according to the following requirements and utilities Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.

- K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas [2 inches above finished floor level.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.
- K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 1. Plain-End PE Pipe and Fittings: Use butt fusion.
 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 PAINTING

- A. Painting of piped utility systems, equipment, and components is specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 1. Stenciled Markers: According to ASME A13.1.
 2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
 3. Locate pipe markers on exposed piping according to the following:
 4. Near each valve and control device.
 5. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 6. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
 7. At manholes and similar access points that permit view of concealed piping.
 8. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
 1. Lettering Size: Minimum 1/4-inch-high for name of unit if viewing distance is less than 24 inches, 1/2-inch-high for distances up to 72 inches, and proportionately larger lettering

for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.9 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section 055000 "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.11 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION #33 05 00

SECTION 33 11 00 - WATER DISTRIBUTION SYSTEM (PVC)

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. These specifications shall govern the furnishing and placing of water distribution lines, fittings, valves, fire hydrants, and other appurtenances. The pipe and accessories shall be installed in accordance with the requirements of these specifications at the locations and depths indicated on the plans, and shall be of the classes, sizes and dimensions shown thereon. The installation of pipe shall include all joints, connections to new or existing pipes, and installation of all fittings, valves, fire hydrants, and appurtenances.

1.2 GENERAL

- A. Piping for water mains shall be of the type and materials specified herein, at the Contractor's option, unless otherwise indicated on the drawings or in this section. The pipe and accessories shall be new and unused. The interior of the pipe shall be thoroughly cleaned of foreign matters before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells and joints. Any pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water, or when trench or weather are unsuitable for the work. Water shall be kept out of the trench until the jointing is complete. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipes or fittings. Any section of pipe found to be defective before or after laying shall be replaced with sound pipe without additional expense to the Owner.

1.3 SUBMITTALS

- A. Submit product data and shop drawings for ALL items to be installed.
- B. Refer to Section 01 33 00 for submittal procedures.

1.4 WATER LINE - SANITARY SEWER LINE CROSSINGS

- A. The water pipe shall not be laid closer horizontally than 9 feet in all directions and parallel lines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following shall apply. The sewer line need not be disturbed where the water line shall be installed parallel to an existing sewer line that shows no evidence of leakage and the water line is installed above the sewer line a minimum of two feet vertically and four feet horizontally. Should excavation for the water line produce evidence that the sewer is leaking, the sewer line shall be replaced as described in SECTION 33 33 13 - SANITARY SEWER LINES. The sewer line shall not be disturbed where a new water line is to cross over (by two feet or more) existing sewer lines showing no evidence of leakage.

1.5 METHOD OF MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for materials and labor performed under this section. Include all costs in the lump sum price.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All pipe shall be new and made in the United States. All plastic pipe must also bear the National Sanitation Foundation Seal of Approval (NSF-PW) and have an ASTM design pressure rating of at least 150 psi or a standard dimension ratio of 26 or less. Water Distribution Lines must be installed in accordance with the manufacturer's instructions. All water Line materials and appurtenances shall comply with Section 290.44(b) of the Texas Natural Resource Conservation Commission Rules and Regulations for Public Water Systems regarding lead banned from piping and joints.

2.2 POLYVINYL CHLORIDE (PVC) PIPE

- A. Requirements for unplasticized polyvinyl chloride (PVC) pipe with bell joints which are integral to the pipe and are well thickened so that standard dimension ratios are maintained or exceeded.
- B. Plastic pipe in 4" and larger sizes shall conform to all requirements of AWWA C900 - DR 18, Class 150.
- C. Plastic pipe in 2", 2 1/2" and 3" sizes shall conform to all requirements of ASTM D 2241 for PVC pipe and be pressure rated at 200 psi with a standard dimension ratio (SDR) of 21 for Class 200 for both barrel and bell dimensions.
- D. Plastic pipe in sizes smaller than 2" shall conform to all requirements of Schedule 40 and have Schedule 80 fittings.

2.3 COPPER TUBING

- A. All 3/4", 1", 1-1/2" and 2" copper tubes for underground service shall Be Type "K" soft annealed with the proper bending temper. All 3/4" And 1" tubes shall be furnished in coils, each containing 60 feet; FLAT coils are preferred. Other diameters of tubes shall be furnished in straight lengths of 20 feet.

2.4 BRASS FITTINGS

- A. All brass fittings shall conform to ASTM Specifications B-62- 52 And shall be those manufactured by the Mueller Company or preapproved equivalent.

2.5 FITTINGS

- A. All fittings shall be cast iron or ductile iron and shall conform to the latest edition of AWWA Specifications.
- B. All ductile iron fittings shall be coated outside with a bituminous coating of either coal tar or asphalt. The inside coating shall be a cement-mortar lining in accordance with AWWA Specification.
- C. All fittings shall be new and made in the United States.
- D. All ductile iron fittings shall be approved by Underwriters Laboratories and shall be accepted by the State Fire Insurance Commission for use in city water distribution systems without penalty.
- E. Rubber gaskets for these fittings shall be manufactured in accordance with AWWA specifications.

2.6 GATE VALVES

- A. All gate valves shall be designed for a cold hydrostatic working pressure of 175 pounds per square inch for valves with diameters of 3-12 inches, inclusive with shop test of 300 pounds per square inch and a working pressure of 150 pounds per square inch for valves with diameters of 16-48 inches, inclusive with shop test to 300 pounds per square inch. All gate valves shall conform to the requirements of AWWA C500-86 Specification. Valves will be equipped with O-ring stem seals.
- B. Gate valves shall be iron body, *resilient seated*, non-rising stem conforming to the requirements of AWWA C509-87 and shall open counter-clockwise. Tapping valves shall be flanged to fit a tapping sleeve on one side and shall be mechanical joint on the other side, with provisions for attaching a standard tapping machine. Gate Valves, fourteen (14) inches and smaller, shall be designed for vertical installation; gate valves, sixteen (16) inches and larger, shall be designed for operation with the stem horizontal or vertical as shown on the plans. Horizontal valves shall be provided with enclosed lubricated bevel gears, bronze gate roller and tracks, bypass valve, and two (2) inch operating nuts on main and bypass valves. Vertically mounted valves sixteen (16) inches and larger shall be designed for operation with the stem vertical and shall be provided with enclosed lubricated spur gears, bypass valve and two (2) inch operating nuts on main and bypass valves. Valves in two (2) inch cast iron screw joint pipe may be two and one-half (2-1/2) inches brass, non-rising stem, wedge disc with thread hubs. Gate valves shall be Mueller, Stockham, M & H or a preapproved equivalent.
- C. Unless otherwise specified, all gate valves shall be installed complete with valve box.

2.7 FIRE HYDRANTS

- A. Fire hydrants shall be Mueller Super Centurion or an approved equivalent.
- B. Each hydrant shall be factory tested to a hydrostatic pressure of 300 psi with valve in both the open and closed positions. The direction of opening nut shall be counterclockwise and shall be cast on the head of the hydrant. Hose nozzles shall be bronze or non-corrosive metal and threads shall be national standard. The main valve opening shall be either five and one-fourth (5-1/4) inches in diameter or six and one-fourth caps shall be provided with gaskets. Bury length shall be three and one-half (3-1/2) feet unless otherwise noted on the plans. Hydrants shall be provided with "dry top" which prevents stem threads from contacting water, and "break-off" type barrel and stem.
- C. Hydrants shall be painted with shop coating in accordance with AWWA C502 specification. Final coats of paint will be applied by Contractor in accordance with fire department requirements.
- D. Contractor shall verify and make nozzle threads consistent with local fire department.

2.8 AIR VALVES

- A. Air valves shall be of the type indicated on the plans. The assembly shall not leak nor shall the valve stick under service conditions.

2.9 CORPORATION COCKS

- A. Corporation cocks shall be of the size specified on the plans. Inlet threads shall be Mueller thread or approved equal. Outlet threads shall be one size larger than listed cock size. Corporation cocks shall be Mueller, H-15000 or a preapproved equivalent.

2.10 VALVE BOXES

- A. Valve boxes shall be cast iron, adjustable height with cover marked "water". Valve boxes shall be Alamo Iron Works #813-30 or a preapproved equivalent.

2.11 WATER METERS

- A. Water meters shall conform to the requirements of AWWA C700, latest revision and shall be of the displacement type. Case shall be bronze, and the register shall be sealed. Accuracy shall be at least 100% plus or minus 1.5% of actual through put. Maximum operating pressure shall be 150 psi. Unless noted otherwise, meters shall be as manufactured by Sensus Technologies, Inc. or a preapproved equivalent.
- B. Boxes for water meters shall be of a key-lock type.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

- A. Unless otherwise specified, the provisions of this section shall conform to AWWA C600-64 specifications.

3.2 LAYING AND JOINTING

- A. Pipe, fittings, valves, and hydrants shall be carefully handled to avoid damage. While they are suspended over the trench, before lowering, they shall be inspected for defects and rung with a light hammer to detect cracks. To ensure proper seating for the spigot and against the shoulders of the bell, each joint shall be lightly swung against the last joint laid before unhooking the sling. Joints of small diameter pipe, installed by hand, shall be properly seated by using an iron bar or other suitable lever to force the spigot end against the shoulders of the bell of the last previously laid joint. Before any pipe is laid, all dirt shall be removed from the inside, and all lumps, blisters, excess tar coat, dirt, oil, grease, and moisture shall be removed from inside the bell and from outside the spigot end. All pipe shall be laid and maintained to the lines and grades shown on the plans or as established on the ground by the Engineer. Wherever it is necessary to deflect pipe from a straight line, the degree of deflection at each joint shall not exceed the maximum deflection recommended by the manufacturers of the pipe being laid. Bell ends shall face the direction of laying. After pipe is laid, care shall be taken to avoid the entrance of dirt, water or other substances by the use of tight bulkheads or plugs.
- B. Gasket material shall be kept in clean containers and shall not be allowed to come in contact with the ground. Gasket material which has become contaminated or dirty shall be destroyed.
- C. Mechanical joints shall be installed in accordance with the manufacturer's recommendations.
- D. Unless otherwise shown, valves shall be located on the extension of street property line. Every valve, including bypass valves, shall be provided with a valve box. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the cover flush with the pavement surface or such other level as directed.
- E. Hydrants shall be located as shown on the Plans and in a manner that will provide complete accessibility and will prevent damage from vehicles. All hydrants shall stand plumb and shall have their pumper connections at right angles to the street. When placed immediately behind the curb, the hydrant barrel shall be set so that no portion of the steamer or hose connection cap will be less than six (6) inches from the gutter face of the curb.
- F. Minimum cover on water lines shall be forty-eight (48) inches unless otherwise specified, but in no case shall the top of any water line be less than 24 inches below the finished ground surface.

3.3 EXCAVATION

- A. All excavations are to be by the open-trench method, unless the Engineer orders that certain sections of the mains are to be laid in tunnels or bored.
- B. The minimum width of the bottom of the trench shall be such that there will be six inches space on each side between the pipe and the walls of the trench. The width of the trench at the surface is not to be less than at the bottom.
- C. When excavating machinery is being used, the same shall cut the trench to a grade slightly higher than the bury indicated by the proposal and the trench shall then be fine graded.
- D. The trench must always be opened and excavated to the finished grade for a distance of at least 50 feet in advance of the last made-up joint. Water mains into which the mains under construction are to be connected must be located well in advance of such connection to allow for possible adjustment of alignment and/or grade.
- E. Bell holes must be excavated in advance of placing the pipe. Materials used shall be placed at locations so as not to interfere unnecessarily with the use of the streets by the public, and not more than two streets intersections shall be closed at any time. The street surface along the line of the trench must be kept free of surplus spoil.
- F. The expense of restoring the original condition of improved property in connection with grass, shrubs or any other improvements must be borne by the Contractor. All trees adjacent to the trench must be protected and the trees on public or private property must not be cut unless permission, in writing, is granted.

3.4 BEDDING

- A. Sand bedding shall be as shown on the Plans with a minimum compacted depth of six inches.

3.5 ROCK EXCAVATION

- A. No rock is anticipated, and no extra compensation will be allowed for rock excavation.

3.6 JACKING, BORING & TUNNELING

- A. This item shall govern for the furnishing and installation of pipe by the methods of jacking, boring or tunneling as shown on the Plans and in conformity with this Specification.
- B. Pipe shall be of the size, type, and class specified on the Plans, or other types as may be specified by the Engineer or designated on the Plans.
- C. Jacking: If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner satisfactory to the Engineer to prevent earth caving.
- D. Where pipe is required to be installed under railroad embankments or under highways, streets, or other facilities by jacking or boring methods, construction shall be made in such a manner that will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Engineer, until such time as the backfill has been completed and then shall be removed from the site.

- E. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.
- F. The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of handling, including the design for the jacking head, jacking support of back stop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.
- G. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than two inches (2") may be provided for the upper half of the pipe. This clearance is to be tapered off to zero at the point where the excavation conforms to the contour of the pipe. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two feet (2') in any case. This distance shall be decreased on instructions from the Engineer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe.
- H. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Engineer will be permitted only to the extent of one inch (1") in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans. If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto pipe.
- I. When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.
- J. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense.
- K. The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.
- L. Boring: The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under "Jacking". The location of the pit shall meet the approval of the Engineer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method approximately a two-inch (2") pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit.
- M. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings. Jetting will not be permitted.
- N. In unconsolidated soil formations a gel-forming colloidal drilling fluid consisting of at least 10% of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the

pipe immediately thereafter.

- O. Allowable variation from line and grade shall be as specified under "Jacking". Overcutting in excess of one inch (1") shall be remedied by pressure grouting the entire length of the installation.
- P. Tunneling: Where the characteristics of the soil or the size of the proposed pipe would make the use of tunneling more satisfactory than jacking or boring, or where called for on the Plans, a tunneling method may be used.
- Q. The excavation for pits and the installation of shoring shall be as outlined above under "Jacking".
- R. The lining of the tunnel shall be of steel of sufficient strength to support the overburden. The Contractor shall submit his proposed liner method to the Engineer for review. Review by the Engineer shall not relieve the Contractor of the responsibility for the adequacy of the liner method.
- S. The space between the liner plate and the limits of excavation shall be pressure-grouted or mud-jacked.
- T. Access holes for pouring concrete shall be spaced at maximum intervals of ten feet.
- U. If corrugated galvanized metal pipe is used, joints may be made by field bolting or by connecting bands, whichever is feasible.
- V. Clean-up: Contractor's equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.
- W. The Owner shall have the right to make connections with and operate all or any part of the main when, in the opinion of the Engineer, such connection does not in any way interfere with the progress of the work, but it is understood that by making such use or connections the Owner does not accept the sewer or waive his right to object to any defect found therein, until the same has been finally inspected by the Engineer and found to be in accordance with the specifications.

3.7 CROSSING STATE HIGHWAYS AND RAILROADS

- A. When water lines cross highways, railroads, or town streets under the jurisdiction of the TxDOT or other public body or corporation, the Contractor shall secure permission from the controlling authority before installing such lines.

3.8 WET CONNECTIONS

- A. Wet connections are defined as connections made to a line in the existing system by interrupting water service. They shall be made at such points as are shown on the plans or as designated by the Engineer. The method and the equipment to be used shall be submitted to the Engineer for approval before any work is done.
- B. Any time that the interruption of water service in the existing system is necessary because of operations under this contract, the Contractor shall notify the City Water Superintendent forty-eight (48) hours in advance. The Contractor will not operate any valve in the existing water system.

3.9 LOWERING OF EXISTING MAINS

- A. When a main is to be lowered in order to conform with new construction, the initial excavation shall be done in such a manner as to permit the mains to rest on several dirt benches, or wooden blocks if soil conditions are unsatisfactory for the benches. The pipe shall then be supported by ropes, cables or chains to overhead supports; the dirt benches or wooden block removed, and the pipe

slowly and evenly lowered into position. After the mains have been lowered, each damaged joint must be re-tightened as directed by the Engineer.

3.10 REMOVING PIPE

- A. Salvageable joint materials from each joint of the pipe must be removed and reclaimed for the Owner and all corporation cocks disconnected and the holes plugged with plugs furnished by the Owner before the pipe is raised from its original position. After raising the pipe from the trench, it shall be pulled apart at the joints and all foreign material removed from the bells and spigots.
- B. All removed materials are to remain the property of the Owner and shall be hauled to the Owner's storage yard.
- C. The unit bid prices for removing mains shall include the removal, the cleaning of exterior and connection surface and hauling to designated storage yards, of all fittings, valves, flushing valves, and other appurtenances.

3.11 TRENCH BACKFILL

- A. All trench backfill above pipe embedment shall conform to the following requirements:
- B. Tamped backfill placed in six-inch (6") layers and compacted to 95% density will be required for the full depth of the trench beneath pavement, surfacing, driveways, curbs, gutters, walks, or other surface construction or structures as well as beneath street, road, or highway shoulders.
- C. In areas other than that described above, backfill shall be placed and tamped in six inch (6") layers until one foot above top of the pipe, then the balance of the backfill shall be placed in twelve inch (12") layers with Compaction approximately equal to that of the adjacent undisturbed material. To compensate for settlement below surface grade backfill material shall be added as necessary and compacted.

3.12 SURPLUS EARTH

- A. Any surplus excavated material shall be disposed of as directed by the Engineer. If the Engineer notifies the Contractor that the Owner does not have use for this material, it shall become the property of the Contractor to dispose of as he wishes without injury to the Owner or any individual.

3.13 STREET SURFACES

- A. In all streets the surface of the trenches after being refilled, dried and settled, shall be finished in the most workmanlike manner without needless delay and shall in every respect be equal in quality, character, material and workmanship to the street improvements existing over the line of the trench immediately prior to making the excavation. The expense of restoring the streets must be included in the price bid per linear foot for mains, except as otherwise provided herein.
- B. All concrete paving, road gravel, and road shell ordered placed on streets will be paid for at the unit price bid.
- C. On gravel, shell and asphalt surfaced streets, the trench shall be filled as otherwise specified up to within eight inches of the surface of the street. The trench shall then be filled with gravel or shell, as ordered by the Engineer, to a point approximately one (1) inch higher than the street level. After all other work is completed and before the job is finally accepted, the Contractor shall go back and place such additional gravel or shell as is ordered by the Engineer. No extra payment for road gravel or stabilized shell.
- D. On concrete streets the trenches shall be filled as otherwise specified within six (6) inches of the

surface of the street, and then filled with road gravel or shell to a point approximately one (1) inch higher than the street level. After all other work is completed, the Contractor shall go back and remove sufficient shell and install six (6) inches of concrete as ordered by the Engineer. The concrete used shall be paid for at the unit price bid in the proposal schedules.

- E. On asphalt surfaced streets, the gravel or shell base shall be placed as stated above. At such time as directed by the Engineer, the gravel or shell base shall be leveled smooth approximately one (1) inch below the existing asphalt surface. The new asphalt pavement shall then be placed and rolled or tamped to a smooth and even surface.

3.14 CROSSINGS TO BE KEPT OPEN

- A. At such street crossings and other intermediate points as may be designated by the Engineer, the trenches shall be bridged in such proper and secure manner as to prevent any serious interruption of travel upon the roadway and sidewalks, the cost thereof to be borne by the Contractor.
- B. Clean Up: Contractors equipment, surplus material and surplus earth shall be removed from the job following the final test of mains and all street surfaces replaced before the final estimate will be approved.
- C. Laying Pipe: In general, the bottom of the trench shall be shaped to give full support to the lower quarter of each pipe. If the foundation is rock or other hard material, a bed of sand or suitable earth shall be placed upon the subgrade and well compacted. The thickness of the bed shall be not less than two (2) inches nor more than six (6) inches. If the foundation is of such material or if conditions are such that the pipe cannot be otherwise properly supported or if the load on the pipe so requires, a concrete cradle as hereinafter specified shall be provided. In all cases water shall be kept out of the trench until the masonry or jointing material has sufficiently hardened. The pipe shall be laid to grade shown on the plans or as directed by the Engineer. Each pipe shall be inspected for defects prior to being lowered into the trench and shall be carefully cleaned in both bell and spigot. Pipe laying shall proceed up-grade with spigot ends pointing in direction of flow. Pipes shall be laid so that each pipe shall rest upon the full length of its barrel with holes excavated to accommodate bells. Except by special permission, no pipe shall be laid except in the presence of an inspector. Any defective pipe laid or any pipe which has had its grade of joint disturbed after laying shall be taken up and replaced.
- D. Before joining the inside of the bells and outside of the spigots shall be dry and clean. The joint shall be made as recommended by the manufacturer of the joint material. Water shall not be allowed in the trenches while the pipes are being laid. The Contractor shall not open up more trenches than the available pumping facilities are able to de-water, to the satisfaction of the Engineer. Bells shall be entirely free of water when joints are made, regardless of the type of joint, and no water shall be allowed to rise over the joint until it has set.

3.15 HOUSE CONNECTIONS

- A. House connections to main pipe shall be made by tapping the main and installed corporation cock of the size designated. The corporation cock shall be screwed securely into position. The copper service, polyethylene or butylene pipe shall be connected to the corporation cock and laid in accordance with the specifications contained herein for laying pipe.

3.16 INSTALLING WATER METERS AND METER BOXES

- A. Water Meters: The ground shall be excavated to such depth that the top of the box is flush with normal ground level. The tail piece of the meter shall be inserted into the service lines as near to the curb cock as possible, or directly into the curb cock. The meter shall then be set in such position that the bottom of the meter is at least two (2) inches above ground. The house side of the meter shall then be connected to the service line running to the house. It is essential that the meters shall

be set plumb and in line with the service line and all connections made in a neat and workmanlike manner.

- B. Meter Boxes: The meter box shall be set on firm ground so that the top of the meter box is flush with the ground surface, and the box is level and plumb. Ground shall be carefully backfilled and tamped around the meter box to leave a neat appearance.

3.17 SETTING FIRE HYDRANTS

- A. Fire hydrants shall be set where shown on the plans or ordered by the Engineer.
- B. Excavate underneath the drain outlet of each fire hydrant a space twelve (12) inches square and six (6) inches deep and fill with gravel. Place the gravel up around bottom of the flushing hydrant not less than three (3) inches above the drain outlet. Not less than two (2) cubic feet of gravel shall be placed around each flushing hydrant. The gravel shall be carefully covered with a layer of one ply roofing paper before trench around the hydrant is refilled. All hydrants shall be carefully blocked and placed to prevent expansion of stub line from water pressure. See plan sheet for blocking details.

3.18 STERILIZATION OF PIPELINES

- A. Unless otherwise specified, sterilization of new water lines shall be done in accordance with AWWA C651-86 specification.
- B. The contractor shall furnish all labor equipment, and materials necessary for the sterilization of the new pipelines, which shall be sterilized before being tested and placed in service. The lines shall be sterilized by the application of a chlorinating agent. The chlorinating agent may be liquid chlorine, liquid chlorine gas-water mixture, or a calcium hypochlorite solution, which shall be fed into the lines through a suitable solution-feed device or other methods approved by Engineer. The chlorinating agent shall be applied at or near the point from which the line is being filled, and through a corporation stop or other approved connection inserted in the horizontal axis of the newly laid pipe. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly, and the rate of water entering the pipe that the chlorine dose applied to the water entering the line shall be a minimum of 50 ppm of chlorine residual of not less than twenty five (25) ppm after twenty-four (24) hours standing in the pipe. At the end of the retention period, all treated water shall be thoroughly flushed from the lines until the replacement water in the lines shall have a chlorine residual of not more than 0.4 parts per million.
- C. Solvent cemented or welded joint pipes shall be sterilized using a sterilizing agent other than liquid chlorine and/or calcium hydrochloride.
- D. Where no suitable outlet is available for flushing dead ends, the Contractor shall furnish and install outlet valves of sufficient size to adequately flush the new mains at the locations designated by the Engineer, for which payment shall be made at the unit price bid for the size valve installed. After the lines are sterilized and flushed and tested as specified above, samples of water shall be taken from the mains for bacteriological tests. If the samples fail to meet the health departments standard requirements, the disinfection process as outlined above shall be repeated and continued until the tests show results that meet the health departments requirements.

3.19 HYDROSTATIC TEST

- A. The Contractor shall provide all necessary equipment and shall perform all work required in connection with the tests. All pressure pipe installations shall be tested for leakage in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours' notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.

- B. The test pressure shall be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four (4) hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air. There will be no extra charge to the Owner for venting.
- C. At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.
 - 1. $L = SD((P)^{1/2})/133,200$, where L = leakage in gal/hr
 - 2. S = length of pipe in feet
 - 3. D = inside diameter of pipe in inches
 - 4. P = pressure in pounds per square inch
- D. If the quantity of leakage exceeds the maximum amount calculated, the failed section will be rejected and not accepted until it meets the above requirements.
- E. Upon completion of all sterilization and testing, the Contractor shall provide personnel to open all valves and operate all hydrants, as directed, in the presence of a representative of the Engineer.

END OF SECTION 33 11 00

SECTION 33 11 00.15 - DUCTILE IRON PIPE AND FITTINGS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ductile iron pipe and fittings for water lines, wastewater force mains, gravity sanitary sewers, and storm sewers.

1.02 RELATED SECTIONS

- A. Section 01270 – Measurement and Payment
- B. Section 01330 – Submittal Procedures
- C. Section 02105 – Chemical Sampling and Analysis
- D. Section 02511 – Water Lines
- E. Section 02515 – Hydrostatic Testing of Pipelines
- F. Section 02531 – Gravity Sanitary Sewers
- G. Section 02532 – Sanitary Sewer Force Mains
- H. Section 02553 – Point Repairs and Obstruction Removals
- I. Section 02631 – Storm Sewers
- J. Section 16640 – Cathodic Protection for Pipelines

1.03 MEASUREMENT AND PAYMENT

- A. Unit Prices.
 - 1. No separate payment will be made for ductile iron pipe and fittings under this Section, with the exception of extra fittings in place. Include cost in unit prices for work as specified in the following Sections, as applicable:
 - a. Section 02511 - Water lines
 - b. Section 02531 - Gravity Sanitary Sewers
 - c. Section 02532 - Sanitary Sewer Force Mains
 - d. Section 02631 - Storm Sewers

2. Refer to Section 01270 - Measurement and Payment for unit price procedures.

- B. Extra Ductile Iron Compact Fittings in Place shall be for additional fittings required to complete job. This is not to exclude extension of pipe across driveway or intersection for purpose of terminating line in more advantageous position. This determination shall be at discretion of Project Manager. This bid item includes additional fittings as may be necessary to complete job in conformance with intent of Drawings.

1.04 REFERENCES

- A. ANSI A 21.4 (AWWA C 104) - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
- B. ANSI A 21.10 (AWWA C 110) - Standard for Ductile-Iron and Gray-Iron Fittings, 3- in. through 48-in.
- C. ANSI A 21.11 (AWWA C 111) - Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- D. ANSI A 21.15 (AWWA C 115) - Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.
- E. ANSI A 21.16 (AWWA C 116) - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings.
- F. ANSI A 21.50 (AWWA C 150) - Standard for Thickness Design of Ductile-Iron Pipe.
- G. ANSI A 21.51 (AWWA C 151) - Standard for Ductile-Iron Pipe, Centrifugally Cast .
- H. ANSI A 21.53 (AWWA C 153) - Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.
- I. ANSI/AWS D11.2 –Guide for Welding Iron Castings.
- J. ASME B 16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- K. ASTM D 1248 - Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.
- L. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- M. ASTM G 62 - Standard Test Methods for Holiday Detection in Pipeline Coatings.
- N. AWWA C 104/ANSI A 21.4 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

- O. AWWA C 110/ANSI A 21.10 - Standard for Ductile-Iron and Gray-Iron Fittings, 3- in. through 48-in.
- P. AWWA C 111/ANSI A 21.11 - Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- Q. AWWA C 115/ANSI A 21.15 - Standard for Flanged Ductile-Iron Pipe With Ductile- Iron or Gray-Iron Threaded Flanges.
- R. AWWA C 116/ANSI A21.16 - Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings.
- S. AWWA C 150/ANSI A 21.50 - Standard for Thickness Design of Ductile-Iron Pipe.
- T. AWWA C 151/ANSI A 21.51 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
- U. AWWA C 153/ANSI A 21.53 - Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.
- V. AWWA C 105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
- W. AWWA C 300 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.
- X. AWWA C 600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
- Y. AWWA M 41 – Ductile-Iron Pipe and Fittings.
- Z. SSPC-SP 6 - Steel Structures Painting Council, Commercial Blast Cleaning.
- AA. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
- BB. American Association of State Highway Transportation Officials (AASHTO).
- CC. DIPRA – Thrust Restraint Design for Ductile Iron Pipe.
- DD. NSF/ANSI 61 – Drinking Water System Components – Health Effects

1.05 SUBMITTALS

- A. Conform to requirements of Section 01330 - Submittal Procedures.
- B. For pipes 16 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing the following:
 - 1. Manufacturer's pipe design calculations.

2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Project Manager. Provide final approved lay schedule on CD-ROM in Adobe portable document format (*.PDF).
 3. Calculations and limits of thrust restraint shall be based on AWWA M41 or DIPRA Thrust Restraint for Ductile Iron Pipe, latest edition.
 4. Class and length of joint.
- C. Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A 21.51.
- D. Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11.
- E. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE

- A. Ductile Iron Pipe Barrels: Shall conform to AWWA C115, C150 and C151 and bear mark of Underwriters' Laboratories approval. Provide minimum thickness Class 52 for sanitary sewers. Unless otherwise shown on Drawings, use a minimum Pressure Class 250 for water lines less than or equal to 20-inch diameter. For 24-inch and larger, design for project specific hydraulics as per AWWA C150. Use minimum Pressure Class 350 for water lines in casing or trenchless construction and for flanged pipe.
- B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.
- C. For 24-inch and larger water lines, furnish and install cathodic protection in accordance with Section 16640 - Cathodic Protection for Pipelines
- D. For sanitary sewer lines, modify pipe for cathodic protection in accordance with Section 16640 - Cathodic Protection for Pipelines. In lieu of furnishing ductile iron pipe with cathodic protection system, furnish ductile iron pipe with polyethylene encasement, provided the following criteria is met:
1. Provide minimum thickness class.

2. Provide polyethylene encasement material and installation in accordance with AWWA C105, and backfill as specified. Minimum of two complete wraps of 8-mil-thick polyethylene.
 3. Use polyethylene encasement for open cut installations only. For augered sections or sections installed inside a casing, provide coating in accordance with paragraph 2.05 D.1.
 4. Adhere to other requirements specified herein (e.g., insulation kits, etc.).
- E. For use of pressure class pipe for water lines, design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HL-93 loading, AREMA E-80 loads and depths of bury as indicated on Drawings. Design pipes with Marston's earth loads for a transition width trench for zero to 16 feet of cover. Use Marston's earth loads for a trench width of O.D. (of pipe) + 4 feet for pipe greater than 16 feet of cover. Use Marston's equations for a trench condition in both open-cut and tunnel applications. Design for most critical groundwater level condition. Pipe design conditions:
1. Working pressure = 150 psi.
 2. Hydrostatic field test pressure = 150 psi.
 3. Maximum pressure due to surge = 225 psi.
 4. Minimum Pressure due to surge = -10 psi.
 5. Design tensile stress due to surge or hydrostatic test pressure: No greater than 50% minimum yield.
 6. Design bending stress due to combined earth loads and surge or hydrostatic test pressure: No greater than 48,000 psi.
 7. Unit weight of fill 2' 120 pcf.
 8. Deflection lag factor (DI) = 1.2.
 9. Bedding constant (K) = 0.1.
 10. Moment coefficient = 0.16.
 11. Fully saturated soil conditions $h_w = h = \text{depth of cover above top of pipe}$.
- F. Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.

- G. Pipe Manufacturer for large diameter water lines: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

Line Diameter	Required Bends*
20 and 24 inches	Four 45° bends per 5,000 LF of water line
> 24 inches	Four 22.5° bends per 10,000 LF of water line
*Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer's option (i.e. two 22.5° bends are equivalent to one 45° bend) and will be counted as one fitting.	

Manufacturer or supplier must be capable of delivering bends to job site within 12 hours of notification. Use fittings at direction of Project Manager where unforeseen obstacles are encountered during construction. These fittings are in addition to any fittings called out in construction documents and must be available at all times.

- H. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Project Manager.
- I. Clearly mark pipe section to show location and thickness/pressure class color coded.
- J. No welding will be permitted on Ductile Iron Pipe except at restrained joint spigots or fittings as per ANSW/AWS D11.2. No field welding is allowed.

2.02 JOINTS

- A. Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications.
1. For sanitary sewer lines with bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.
 2. For water lines with bolted joints, conform to requirements of AWWA C111; provide Denso or approved equal petrolatum based tape coating system for exposed portion of nuts and bolts.
- B. Where required by Drawings, provide approved restrained joints for buried service. Refer to City's List of Approval Products for approved joint restraint mechanisms.
- C. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.

- D. Provide for restrained joints designed to meet test pressures required under Section 02515 - Hydrostatic Testing of Pipelines or Section 02532 - Sanitary Sewer Force Mains, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.
- E. Electrical Bond Wires: Bond Wires; use stranded, copper cable furnished with high molecular weight polyethylene insulation (HMWPE). Use wire gauge (AWG) as shown on Drawings.
- F. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by Project Manager. When other methods are deemed satisfactory, install at no additional cost to City.

2.03 GASKETS

- A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477; for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.
- B. For pipes to be installed in potentially contaminated areas, see Specification Section 02105 – Chemical Sampling and Analysis.
- C. For Pipes to be installed in any other contaminated areas, use gaskets as recommended by the Pipe Manufacturer, Engineer of the Record and approved by City Engineer prior to installation.

2.04 FITTINGS

- A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.
- B. Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.
- C. Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.
- D. Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.
- E. Ductile Iron Compact Fittings: Shall conform to AWWA C153 and shall be:
 - 1. Fusion bonded epoxy lined or
 - 2. Cement mortar lined.

- F. For tangential flanged outlets shown on Drawings, substitute with a tee with an equivalent sized outlet unless otherwise approved by Project Manager.

2.05 COATINGS AND LININGS

- A. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A 21.16 fusion bonded epoxy coating for interior; comply with NSF 61.
- B. Sanitary Sewer and Force Main Interiors:
 - 1. Preparation: Commercial blast cleaning conforming to SSPC-SP6.
 - 2. Liner thickness: Nominal 40 mils, for pipe barrel interior; minimum 6 to 10 mils at gasket groove and outside spigot end to 6-inches back from end.
 - 3. Testing: ASTM G 62, Method B for voids and holidays; provide written certification.
 - 4. Acceptable Lining Materials:
 - a. Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
 - b. Ceramic Epoxy – Protecto 401 or approved equal.
- C. Sanitary Sewer Point Repair Pipe: For pipes which will be lined with high density polyethylene liner pipe or cured-in-place liner, provide cement-lined with seal coat in accordance with ANSI A 21.4. For pipes which will not be provided with named liner, provide pipe as specified in Paragraph 2.05B, Sanitary Sewer and Force Main Interiors.
- D. Exterior:
 - 1. Encasement requirement for water lines.
 - a. Open cut construction method: Provide double wrap polyethylene encasement in accordance with AWWA C105.
 - b. Auger or casing construction method:
 - (1) Double wrap with polyethylene encasement in accordance with AWWA C105. Place circumferential wraps of tape or plastic tie straps at two-foot intervals along the barrel of the pipe, and thoroughly seal each end of the polyethylene tube.
 - 2. Sanitary Sewers: Prime coat and outside asphaltic coating conforming to ANSI A21.10, ANSI A21.15, or ANSI A21.51 for pipe and fittings in open cut excavation and in casings.

- E. For buried sanitary sewer pipes not cathodically protected, provide polyethylene wrap unless otherwise specified or shown. Conform to requirements of AWWA C105.
- F. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners. Alternatively, sanitary sewer lines may use bolts made of Type 304 stainless steel.
- G. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the Phase II Environmental Site Assessment Report. If no alternative coating is specified for water lines, provide polyethylene wrap in potentially contaminated areas.

2.06 MANUFACTURERS

- A. Use pre-approved manufacturers listed in City of Houston approved products.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Conform to installation requirements of Sections 02511 - Water Lines, 02531 - Gravity Sanitary Sewers, 02532 - Sanitary Sewer Force Mains 02631 - Storm Sewers and 02553 - Point Repairs and Obstruction Removal, except as modified in this Section.
- B. Install in accordance with AWWA C 600 and manufacturer's recommendations.
- C. Install double wrap polyethylene encasement in conformance with requirement of AWWA C105.
- D. Holiday Testing.
 - 1. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.
- E. Provide electrical continuity bonding across buried mechanical and push-on joint assemblies, except where insulating flanges are required by Drawings.
 - 1. Provide minimum number of bond wires shown on Drawings. Remove one inch of HMWPE insulation from each of bond wire prior to attaching.
 - 2. Secure wire onto pipe using approved Thermite Welding procedures.
 - 3. Coat bare metal and weld metal after weld is secure. Use coal-tar compound or other compatible coating. For polyurethane coated pipe, use compatible polyurethane coating.

4. Visually inspect Thermite Weld connections for electrical continuity, strength and suitable coating prior to backfilling or placing pipe in augered hole or casing.
- 3.02 FIELD REPAIR OF COATINGS
 - A. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

END OF SECTION 33 11 00.15

SECTION #33 41 00 – STORM UTILITY DRAINAGE PIPING

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Site storm sewer drainage piping, fittings, accessories and bedding.
 - 2. Catch basins, paved area drains, site surface drains and stormwater detention facilities.
 - 3. Connection of building storm water drainage system.
 - 4. Precast concrete, Cast-in-place concrete manholes.
- B. All public work to be performed and materials to be used within the street right-of-way, shall be in accordance with the City of Conroe Design Standards. In the event of a discrepancy between the above-referenced standards, the plans, and/or any portion of this specification section, the order of precedence will be the plans, the City Design Standards, and then these specifications. The Contractor shall contact the engineer in the event of a discrepancy.

1.2 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- B. HDPE: High density polyethylene.
- C. RCP: Reinforced concrete pipe

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: 10-foot head of water (30 kPa). Pipe joints shall be at least silttight, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe materials, fittings and accessories.
 - 2. Drains.
- B. Shop Drawings: For the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of service.

PART 2 – PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Sewer Pipe and Fittings; NPS 6" to 12" ASTM D 3034, SDR 26, with bell-and-spigot ends for gasketed joints with ASTM F 477, elastomeric seals.

2.2 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M), with groove and tongue ends and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets.
 - 1. Class III, Wall B.

2.3 HDPE PIPE AND FITTINGS

- A. Pipe shall have a smooth interior and exterior corrugations.
 - 1. 4-through 10-inch (100 to 250 mm) shall meet AASHTO M252m, Type S.
 - 2. 12- through 60-inch (300 to 1500 mm) shall meet AASHTO M294, Type S or ASTM F2306.
- B. Pipe shall be joined with joints meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306.
- C. 4-through 60-inch (100 to 1500mm) shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
- D. 12- through 60-inch (300 to 1500 mm) diameters shall have a reinforced bell with a bell tolerance device. The bell tolerance shall be installed by the manufacturer.
- E. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306.
- F. To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM C969. Appropriate safety precautions must be used when field-testing any pipe material.
- G. Installation shall be in accordance with ASTM D2321 and manufacturer's published installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameters, the minimum cover shall be 2 ft. (0.6 m) in single run applications.

2.4 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 - 1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
 - 2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 3. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 4. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.5 CLEANOUTS AND PLUGS

- A. Installation shall be in accordance with the details and at locations shown on the drawings.
- B. All cleanouts shall have a 2' x 2' x 6" thick concrete apron.

2.6 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 1. Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.

3. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 4. Riser Sections: 4-inch (102-mm) minimum thickness, and lengths to provide depth indicated.
 5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 6. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
 7. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
 8. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 9. Manhole Frames and Covers: Ferrous; 28-inch ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 30-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 - a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
- B. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete, as required to prevent flotation.
 2. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
 3. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches (1500 mm).
 4. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
 5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
 6. Manhole Frames and Covers: Ferrous; 28-inch ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 30-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 - a. Material: ASTM A 536, Grade 60-40-18 ductile iron, unless otherwise indicated.
 - b. Protective Coating: Foundry-applied, SSPC-Paint 16, coal-tar, epoxy-polyamide paint; 10-mil (0.26-mm) minimum thickness applied to all surfaces, unless otherwise indicated.

2.7 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.
 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

2.8 CATCH BASINS

- A. Installation shall be in accordance with the details and at locations shown on the drawings.

2.9 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to the details and at locations shown on plans.
- B. Frames and Grates: Heavy-duty frames and grates according to the details and at locations shown on plans.

PART 3 – EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. Unshielded flexible couplings for same or minor difference OD pipes.
 - b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
 - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
- B. Special Pipe Fittings: Use for pipe expansion and deflection. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- C. Gravity-Flow, Nonpressure Sewer Piping: As shown on plans.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
2. Install piping with 36-inch (915-mm) minimum cover.
3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
4. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
 - a. Install HDPE pipe according to ASTM D2321.

3.4 PIPE JOINT CONSTRUCTION

- A. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, nonpressure drainage piping according to the following:
 1. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric gasket joints.
 2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 3. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.
- C. Join dissimilar pipe materials with pressure-type couplings.

3.5 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 2. Use extra-heavy-duty, top-loading classification cleanouts in firelane areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 24 by 24 by 6 inches deep. Set with tops 1 inch (25 mm) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 1. Use heavy-duty, top-loading classification drains in vehicle-traffic service areas.
 2. Use extra-heavy-duty, top-loading classification drains in roads areas.
- B. Embed drains in 4-inch (102-mm) minimum depth of concrete around bottom and sides.
- C. Fasten grates to drains if indicated.
- D. Set drain frames and covers with tops flush with pavement surface.
- E. Assemble trench sections with flanged joints.
- F. Embed trench sections in 4-inch (102-mm) minimum concrete around bottom and sides.

3.7 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections according to ASTM C 891.
- C. Construct cast-in-place manholes as indicated.

3.8 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.9 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

- B. Install outlets that spill onto grade, anchored with concrete, where indicated.
- C. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- D. Construct energy dissipaters at outlets, as indicated.

3.10 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.11 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
- C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION #33 41 00

SECTION 40 05 00 - MECHANICAL GENERAL PROVISIONS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Except as modified in this section, General Conditions, Supplementary Conditions, applicable provisions of Division 1, General Requirements, and other provisions and requirements of the contract documents apply to work of Division 15, Mechanical.
- B. Applicable provisions of this section apply to all sections of Division 15, Mechanical.

1.02 PAYMENT

- A. Payment for mechanical equipment will be according to the unit or lump sum price as provide on the Proposal form. If a specific piece of equipment has not been itemized on the Proposal, no separate payment will be made; include cost of such items under other appropriate areas of the work.

1.03 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only, and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.

1.04 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material which is not suitable in this respect.

1.05 SERVICE

- A. Perform all service work required during startup until final acceptance by the owner. Perform service regularly in conformance with the manufacturer's recommendations, and provide the owner with a written report.

1.06 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to/or through the related structures by the equipment, piping, ducts, or other parts of work, rectify such conditions without cost to owner.
- B. As a condition of the manufacturer's warranty, the manufacturer shall provide a written document stating that he or his qualified authorized representative will provide quarterly (once per three month period) inspection of all components supplied for a period of 24 months (two years) from the date of final acceptance by the Engineer. Applicable equipment shall be outlined specifically in the respective section of Division 15. The inspection conducted by the manufacturer's authorized service technician shall include but not be limited to all moving parts, electrical components, wash water systems and stationary alignment of the units. The technician shall review operations and maintenance procedures and upon completion of the inspection, shall present to the owner, through the Engineer, a written report stating the condition of all individual operating components. This is to include but not be limited to alignment, lubrication and wear of all moving parts; electrical characteristics and condition of all motors, solenoids and other electrical devices; other comments relating to the general condition and operation of the equipment. Two (2) year extended inspection service.

1.07 ACCEPTABLE MANUFACTURERS

- A. Where two or more units of same type or class of equipment are required, provide units of single manufacturer. Manufacturer's names and catalog numbers specified under sections of

Division 15 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Equipment of similar design, equal to that specified, will be acceptable based on pre-approval as outlined in the bid proposal.

1.08 SUBMITTALS

- A. Prior to award of the contract, and before orders are placed or shop drawings are submitted, submit a list of equipment and principal materials specified. Give names of manufacturers, catalog and model numbers, and such other supplementary information as necessary for identification.

1.09 SHOP DRAWINGS

- A. Shop drawing procedures are specified in Division 1, General Requirements. Items requiring shop drawings include:
 - 1. Equipment and Materials: All items of equipment and principal materials proposed for installation.
 - 2. Control Systems: Submit detailed control and electrical interlock diagrams showing control devices and wiring.
 - 3. Equipment Rooms: Submit shop drawings of mechanical equipment, rooms/enclosures and, where directed, other complex areas. Show actual equipment to be installed, with piping fully detailed to show clearances, headroom, pipe routing, valve positions, pipe hangers, insulation, and other pertinent information. Prepare drawings to a scale of at least 3/8-inch per foot.
 - 4. Piping/Ductwork: Submit piping shop drawings fully detailed, and indicating centerline elevation of all piping/ductwork above and below grade or finished floor line, and exact size and location of all framed, cast or masonry openings required. Prepare drawings to a scale of at least 1/4-inch per foot.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide bound sets of complete and indexed Operations and Maintenance Manuals (multiple volumes if required). As a minimum, the information provided shall include operating and maintenance instructions, service manuals and instructions, and parts lists applicable to each item of equipment furnished. Delivery of these document sets shall be in a format as designated by the Engineer and is a condition of final acceptance. Operation and maintenance instructions should include all name plate data; design parameters, including field changes; safety procedures; and practical operations and maintenance of the equipment system. Provide only information that pertains to the specific equipment/equipment system supplied.
- B. Upon completion of work, and at a time designated by the engineer, provide services of a competent/certified representative of the contractor for a period of at least 2 days to instruct the owner's representative in the operation and maintenance of the entire equipment system with related components. Operations and Maintenance Manuals shall be complete and approved prior to training. Training shall be conducted from a written syllabus approved a minimum of 10 days prior to any training session.

1.11 OPERATING TESTS

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to insure proper sequence and operation throughout the range of operation. Make adjustments as required to insure proper functioning of all systems. Special tests on individual systems are specified under individual sections.

1.12 LUBRICATION

- A. Provide complete charge of the correct lubricant for each item of equipment requiring

lubrication. Lubricants shall be as tabulated in the Operations and Maintenance Manual.

1.13 REMOVAL OF EXISTING EQUIPMENT

- A. All existing mechanical equipment designated "to be removed" shall be disassembled only to the extent necessary to enable removing it from the existing structure. Said equipment shall become the property of the Contractor unless noted otherwise. Where indicated to be Owner retained equipment, then it shall be stacked in a specified location on site to be later salvaged by the Owner.

PART 2 - PRODUCTS

Not Used.

PART 3- EXECUTION

Not Used.

END OF SECTION 40 05 00

SECTION 40 05 05 – PLANT PIPING

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This work includes furnishing all plant, labor, equipment and materials and performing of all operations required for proper completion, installation and fabrication of all pipe, fittings and accessories required to complete the work as shown on drawings and specified herein.
- B. Refer to other specification sections for additional requirements. Conflicting requirements in other sections shall not supersede the requirements of this section.

1.02 QUALITY ASSURANCE

- A. Provide highest quality workmanship and materials throughout. Furnish equipment manufactured by a manufacturer with at least five years of experience in the design and building of water and waste treatment equipment.

1.03 MISCELLANEOUS ITEMS

- A. Include all supplementary parts necessary to complete each item even though such work may not be definitely shown or specified.

1.04 STANDARD MANUFACTURED PRODUCTS

- A. Details and specifications, for which standard manufactured products are available, are representative guides for requirements of these items. Standard manufactured products conforming to these general requirements will be acceptable if details of construction and installation are approved by Engineer.

1.05 MEASUREMENT

- A. Make measurements any of previously installed construction before fabrication of connecting work, so that all work will fit properly.

1.06 PROJECT RECORD DOCUMENTS

- A. Upon completion of all work, furnish prints showing location and principal details and modifications of piping systems as built.

1.07 SHOP DRAWINGS

- A. Submit shop drawings, product data, and samples as specified in Division 1, General Requirements.

1.08 TRENCH SAFETY

- A. Provide trench safety per all local, state and federal requirements.

1.09 PAYMENT

- A. No separate payment will be made for work performed under this section. Include the cost of such work in the bid form and specified in other sections of this work.

PART 2 - PRODUCTS

2.01 PIPING

A. Ductile Iron Pipe:

1. Ductile iron pipe shall have a mortar lining and be thickness Class No. 150, for a Type 5 laying condition. For other than Type 5 laying pipe shall be designed in accordance with ANSI A21.51 Table 51.1. Where ductile iron pipe is to be buried provide eight (8) mil black virgin polyethylene film wrap as manufactured by Du Pont Alathor or U.S.I. Petrothene resins. Polyethylene shall be held in place with Polyken No. 900 plastic back adhesive tape:
 - a. Lap two (2) inches at each joint.
2. Use flanged joints and fittings for ductile iron pipe installed above ground. Use 304 SS bolts for flanged joints.
3. Use mechanical joints or boltless (push-on) gasketed joints made up strictly in accordance with manufacturer's recommendations for ductile iron pipe installed below ground.
4. Ductile iron flanges are to be furnished in accordance with ANSI A21.15. Flanges are to be ductile iron. All flanged pipe to be shop hydrostatically tested to 125 psi to insure leak-free joints.

B. Steel Pipe: Provide Standard Weight Schedule 40 pipe conforming to ANSI Standard Specification B 36.1. The pipe is to be hot dip galvanized after fabrication unless noted otherwise.

C. Polyvinyl Chloride Pipe (PVC):

1. All PVC chlorine solution pipe shall be Schedule 80 with solvent welded joints.
2. All PVC gravity sewer pipe shall be SDR 26 (ASTM D3334) pressure pipe.
3. All PVC pressure pipe 2" and larger shall be C-900 or C-905 (Class 150) where noted or approved by the Engineer. All fittings used with this piping system are to be mechanical joint, ductile iron with restraint couplings (Megalug 2000 or Stargrip 4000).
4. Smaller than 2" shall be Schedule 80 with solvent welded joints.

D. Concrete Pipe: Provide reinforced concrete pipe conforming to ASTM C76, Class III, with rubber-type gasket joints in accordance with ASTM C 443. Where concrete pipe is proposed for wastewater service (including lift stations), provide Ameron T-lock interior surface treatment or a protective coating as specified by "Concrete Surface Protection".

E. Corrugated Metal Pipe: Provide 14 gauge galvanized, asphalt coated corrugated metal pipe with 2-2/3" X 1/2" corrugations in accordance with AASTHO M 136 and M 190. Lengths to be as indicated on drawings, or as long as practicable.

2.02 FITTINGS

A. Use fittings of same size as pipe they serve. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Reduction in piping size will be made by reducing fittings. Use galvanized fittings for galvanized pipe.

1. Flanged Fittings: Provide 150 pound flanged fittings, constructed of high quality gray-iron or ductile iron castings accurately machined and finished. Dimensions must conform to American Standard for Cast Iron Flanged Fittings. Use cast iron fittings meeting requirements of ANSI B-16.1, Class 125.
2. Mechanical Joint Fittings: Provide 150 pound mechanical joint fittings conforming to ANSI A-21.11 (AWWA C-110). Mechanical joint bolts shall be cathodic to the pipe.

3. Boltless Gasketed Fittings: Provide 150 pound boltless gasketed "O-ring" type fittings conforming to ANSI A-21.11 (AWWA C-110).
4. Threaded Fittings: Provide 150 pound, malleable iron, screwed fittings. Galvanize fittings as specified. Provide pipe with American Standard taper pipe threads.
5. Welded: Provide welded fittings conforming to physical and chemical requirements of ASTM specifications. Provide standard weight, forged steel, long radius pattern, butt welding type fittings with full thickness of metal sustained at all points. Use welding tees when pipes are of same size. Use weld-o-lets to tee a smaller pipe into a larger.
6. Copper: Use solder-type, wrought copper fittings meeting requirements of same material as pipe. Furnish high melting point solder of tin and lead, containing not less than 85 percent tin.
7. PVC: All solvent welded pipe fittings are to be Schedule 80.

2.03 COUPLINGS

- A. Use Dresser or Baker 316 SS Expansion Couplings unless otherwise specified. All components, mid-ring, followers and connecting hardware are to be 316 SS with the exception of nuts which are to be 400 series SS to prevent galling. Gaskets are to be EPDM (or as noted otherwise) for all service connections other than air which is to be Viton (FKM).

2.04 GASKETS

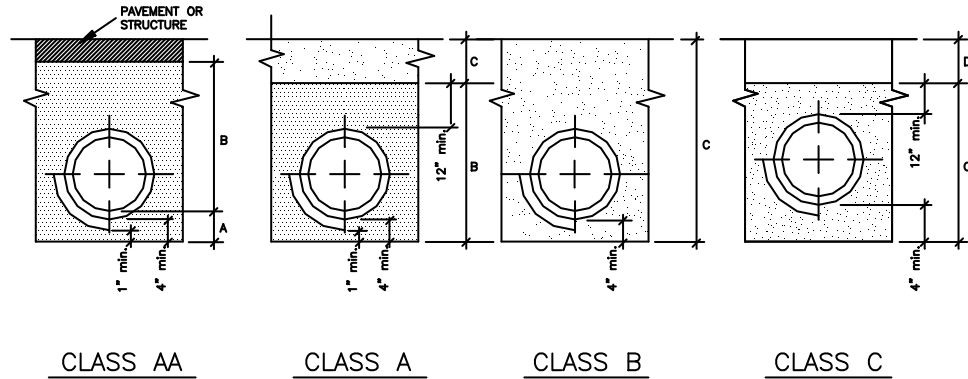
- A. Provide gaskets for all flanged, mechanical joint, or boltless (push-on) piping connections. Provide pipe manufacturer's recommended gaskets for wastewater service with minimum requirements of SBR on non-pressure lines (gravity hydraulics, less than 5 psig); EPDM on pressure lines (greater than 5 psig, force mains) or under structures; Viton (FKM) on all air service lines.
- B. Gaskets for flanged piping are to be full face. Mechanical Joint and Boltless (push-on) are to be tapered "O-ring" style, tyton gaskets.

PART 3 EXECUTION

3.01 EXCAVATION

A. EXCAVATION, TRENCHING AND BACKFILLING

1. Conform to applicable provisions of the section on earthwork in Division 2, Site Construction.
2. Bedding shall be as noted on plans or the following bedding schedule is to be used if nothing is indicated on the plans:
3. All piping under structures & pavement CL-"A-A"
4. Yard Piping:
PVC or ductile iron CL-"B"
5. Reinforced concrete pipe: CL-"A"
6. PVC pipe (Sch. 40 or 80): CL-"C"



"A" - 1.5 SACK/CY CEMENT STABILIZED SAND PLACED BEFORE PIPE IS LAID UP TO FLOW LINE OF PIPE OR ABOVE.

"B" - 1.5 SACK/CY CEMENT STABILIZED SAND, THOROUGHLY RODDED, AND PLACED AFTER PIPE IS LAID.

"C" - BANK SAND PLACED SAME DAY AS PIPE IS LAID.

"D" - CLASS IMA, OR BETTER SOIL AS SPECIFIED IN ASTM D2321.

Note: Class "A" Bedding used on all sewers 18" and larger, unless otherwise specified.

3.02 MANHOLES

- A. Construct manholes in accordance with applicable provisions of sections in Division 2, Site Construction.

3.03 JOINTING

- A. Flanged Joints: When bolting, take care to insure that there is no restraint on the opposite end of the pipe or the fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. Leave one flange free to move in any direction while flange bolts are being tightened. Tighten bolts gradually and at a uniform rate, in such manner that gasket compression is uniform over the entire area of gasket.
 1. Take special care when attaching suction and discharge piping to pumping equipment. Insure that no stresses are transmitted to or imposed on the pump suction and discharge flanges by connected piping. Install and permanently support piping to provide accurate matching of bolt holes and uniform contact over the entire flange. In addition, leave pump connection piping free to move parallel to its longitudinal centerline while the bolts in pump connection flanges are tightened.
 2. Provide maximum flexibility and ease of alignment correction by taking advantage of the slack between the flange bolts and bolt holes for slight angular rotation of connecting flanges. Assemble pump connecting piping with gaskets in place, with only a portion of the flange bolts (no fewer than four per joint) installed. After final alignment and before final bolting, test pump connections for applied piping stresses by loosening flange bolts which, if piping is properly installed, should result in no movement of piping relative to the pump, or opening of the pump connection joints.
- B. Mechanical Joints: Carefully assemble mechanical joints in accordance with the manufacturer's recommendations. If seal is defective, disassemble the joint, thoroughly clean it, and reassemble the joint. Do not over tighten bolts to compensate for poor installation practice.
- C. Push-On Joints: Remove lumps, blisters, and excess coating from the exterior spigot and

interior bell surfaces. Wire brush such surfaces and wipe them clean and dry (free from oil and grease) before placing the spigot in the bell. Take every precaution to prevent foreign material from entering the pipe during installation. Do not place debris, tools, clothing, or other materials in the pipe. Observe and follow instructions and recommendations of the pipe manufacturer, relative to gasket installation and other jointing operations. Lubricate joint surfaces with heavy vegetable soap solution immediately before joint is completed. Suitably bevel each spigot end to facilitate assembly.

- D. Threaded Joints: Make threaded joints using suitable joint compound applied to male threads only. Thoroughly ream field cuts. Make connections carefully so that thread engagement will be secured. Machine cut threads to American National taper pipe thread sizes.
- E. Welded Joints: Make welded joints as recommended by standards of the American Welding Society. Insure complete penetration of deposited metal with base metal. The filler metal must be suitable for use with the base metal. The inside of fittings must be free from globules of weld metal which would restrict the flow or become loose. Do not use mitered joints.
- F. Solder Joints: Prior to making solder joints, cut the pipe square and ream the pipe to full diameter. Thoroughly clean the exterior of the pipe and the socket of the fitting. Polish to bright metal, free from oxidized metal. Apply a thin coat of suitable fluxing compound to both pipe and socket. Fit the parts together immediately. Heat the assembled joint only as required to cause solder to flow. Run joint full with a slight bead on the outside. Wipe to remove excess solder.
- G. Solvent Welding: All PVC joints are to be solvent welded using the manufacturer's recommended system and materials. Other coupling or jointing systems will be noted on plans.
 - 1. When pipe is cut make sure all cuts are perpendicular to the centerline of the pipe. Remove all burrs, chips, and fillings. Make sure pipe surface is clean and dry prior to priming.
 - 2. Do not make solvent welds when the ambient air temperature is less than 40 deg. F or greater than 90 deg. F; nor when the relative humidity is such as to cause a condition of misting or raining.

3.04 HANDLING

- A. Handle pipe, fittings, and accessories to insure their installation in a sound, undamaged condition. Use equipment, tools and methods to prevent damage in unloading, reloading, hauling, and laying pipe and fittings. When using hooks in pipe ends, be sure that the contact surfaces are broad and well padded.

3.05 CUTTING

- A. Cut cast iron pipe in a neat manner, without damage to the pipe. Make cuts smooth, straight, and at right angles to the pipe axis. Use mechanical pipe cutters of an approved type, except in locations where the use of mechanical cutters would be difficult or impracticable. In such locations, cut the pipe with diamond point chisels, saws, or other tools which will cut pipe without damaging impact or shock.

3.06 CLEANING

- A. Thoroughly clean the interior of the pipe and fittings of foreign matter before installation. Keep the interior clean until the work has been accepted.

3.07 INSPECTION

- A. During installation, while the pipe is suspended and hanging free, inspect each pipe and fitting for defects. Tap the pipe with a light hammer to detect cracks. Reject defective, damaged or unsound pipe and fittings and remove them from sight.

3.08 LAYING PIPE

- A. Protect the pipe from lateral displacement by means of pipe embedment material installed as specified in Division 2, Site Work, and as shown.
- B. Under no circumstances should pipe be laid in water. Do not lay pipe under unsuitable weather or trench conditions.
- C. Lay pipe with bell ends facing the direction of the laying except when making closures.

3.09 REACTION ANCHORAGE AND BLOCKING

- A. Install suitable reaction blocking, struts, anchors, clamps, joint harness or other adequate means for preventing movement of pipe caused by unbalanced internal liquid pressure. Pressure can be expected at unlugged tees, Y-branches, and bends deflecting 22-1/2 degrees or more which are installed in piping subjected to internal hydrostatic heads in excess of 15 feet in exposed, or 30 feet in buried piping.
- B. In trenches, fittings must be provided with concrete thrust blocking between the fitting and solid, undisturbed ground in each case, except where solid ground blocking support is not available. At tops of slopes, anchor vertical angle bends with concrete of sufficient weight to resist hydraulic thrust to which pipe will be subjected at maximum pressures. Install the concrete block and anchors so that joints between the pipe and the fittings are accessible for repair. The bearing area of the concrete reaction block against the ground or the trench bank shall be as shown or as directed by engineer in each case.
- C. In the event adequate support against undisturbed ground cannot be obtained, install metal harness anchorage facilities to provide necessary support. Should the lack of solid vertical excavation face be due to careless or otherwise improper trench excavation, no additional payment will be made for furnishing and installing metal harness anchorage in excess of contract value of concrete blocking replaced by such anchorages.
- D. Provide fittings in locations other than trenches, as shown or directed with reaction blocking, struts, anchorages, or other supports. This includes but is not limited to fittings installed in fills or other unstable ground, above grade, or exposed within structures.
- E. Adequately protect from corrosion steel, clamps, rods, bolts, and other metal accessories used in reaction anchorages or joint harness where subject to submergence or contact with earth or other fill material and not encased in concrete. Apply not less than two heavy coats of coal tar coating material to clean, dry metal surfaces. Allow the first coat to become dry and hard before the second coat is applied. Paint the metal surfaces exposed above grade or within structures in accordance with Division 9, Finishes.
- F. Substitution: In lieu of reaction anchorages and blocking for underground pipe and fittings, use push-on, locking type joints such as Lok-Tyton joints manufactured by United States Pipe and Foundry Company. Equip these joints with Lok-Tyton gaskets. Groove the pipe in strict accordance with the manufacturer's recommendations.

3.10 TESTING

A. GRAVITY SEWER LEAKAGE TEST

1. After backfilling and removing debris from each section of sewer line, conduct a line acceptance test under observation of an inspector. Test the sanitary sewer line in strict accordance with the following leakage test using low-pressure air. If the test results indicate an unacceptable installation, locate the source of leakage, correct the defect, and retest until the installation is proven satisfactory.
2. Minimum Requirements for Equipment:
 - a. Control Panel
 - b. Low-pressure air supply connected to control panel

- c. Pneumatic plugs: Of acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
 - d. Air hose from control panel to:
 - i. Air supply
 - ii. Pneumatic plugs
 - iii. Sealed line for pressurizing
 - iv. Sealed line for monitoring internal pressure
3. Testing Pneumatic Plugs: Test plugs before using in actual test installation. Place one length of pipe on ground and seal at both ends with pneumatic plugs to be checked. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. The plugs are acceptable if they remain in place against the test pressure without external aids.
4. Compensation for Ground Water Pressure: Where ground water exists, install a capped piped nipple at the same time the sewer line is placed. Use a 1/2-inch capped pipe nipple approximately 20 inches long. Make the installation through the manhole wall on top of the sewer line where the line enters the manhole.
- a. Immediately before performing the line acceptance test, remove the pipe cap, clear the pipe nipple with air pressure, and connect a clear plastic tube to pipe nipple. Support the tube vertically and allow water to rise in the tube. After the water stops rising, measure the height in feet of water over the invert of the pipe. Divide this height by 2.3 feet/psi to determine the ground water pressure to be used in line testing.
5. Line Testing: After pneumatic plugs have been checked, place plugs in line at manholes or at the end of the line segment and inflate plugs to 25 psig. Introduce low-pressure air into sealed line until the internal air pressure reaches 4 psig greater than the ground water pressure. Allow at least 2 minutes for air pressure to stabilize. If at least 2.5 psig over ground water pressure is maintained disconnect the air hose from the control panel to the air supply and measure the time of the pressure drop between 3.5 and 2.5 above ground water pressure.
- a. The installation is acceptable if the air loss rate does not exceed 0.003 cfm per square foot of internal pipe surface with an average test pressure of 3.0 psig greater than ground water pressure. The line between manholes is within acceptable limits if the time for the 1 psig pressure drop is not less than the time listed below for pipe sizes indicated.

Pipe Diameter in Inches	Minutes Pressure is Maintained
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5
27	13.0
30	14.5
36	17.0

END OF SECTION

SECTION 40 05 61 – GATES AND VALVES

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This work includes furnishing all labor, equipment and materials and performing of all operations required for proper completion, installation and fabrication of all gates, valves, and accessories required to complete the work as shown on drawings and specified herein.
- B. This section provides for furnishing and installing gates and valves for a sewage treatment plant. Refer to related work specified in other sections to coordinate the complete installation.

1.02 QUALITY ASSURANCE

- A. Provide highest quality workmanship and materials throughout. Furnish equipment manufactured by a manufacturer with at least five years of experience in the design and building of water and waste treatment equipment.

1.03 MISCELLANEOUS ITEMS

- A. Include all supplementary parts necessary to complete each item even though such work may not be definitely shown or specified.

1.04 STANDARD MANUFACTURED PRODUCTS

- A. Details and specifications, for which standard manufactured products are available, are representative guides for requirements of these items. Standard manufactured products conforming to these general requirements will be acceptable if details of construction and installation are approved by Engineer.

1.05 MEASUREMENTS

- A. Make measurements of previously installed construction before fabrication of connecting work, so that all work will fit properly.

1.06 PROJECT RECORD DOCUMENT

- A. Upon completion of all work, furnish prints showing location and principal details and modifications of all systems as constructed.

1.07 SHOP DRAWINGS

- A. Submit shop drawings, product data, and samples as specified in Division 1, General Requirements.

1.08 PAYMENT

- A. No separate payment will be made for work performed under this section. Include the cost of such work in the bid form and as specified in other sections of this work.

PART 2 PRODUCTS

2.01 GATES

A. Sluice Gates

1. Gate Frame and Guide: Gate frame and guides shall be cast in one piece and shall be flat back. Size of openings shall be as noted on drawings. Back of frame shall be machined to a plane and drilled to mate anchor bolts. Guides shall be cast as an integral part of frame and be sufficiently long to retain at least one-half of vertical height of slide when it is in full opened position. Guides shall be capable of safely withstanding full thrust due to water pressure and wedging action. Guide grooves shall be accurately machined to provide free movement of slide tongues and to insure proper engagement of wedging devices. Pads shall be cast on guides, and machined and drilled for mounting of wedging devices. Provide gates with wall thimbles (where noted) of a size as indicated on drawings and as manufactured by Waterman, Rodney-Hunt, or preapproved equivalent.
2. Gate Slide: Gate slide shall be cast in one piece with vertical and horizontal ribs, pads for attaching wearing devices, a stem block pocket and a reinforced section around perimeter to provide for mounting of seating faces. Casting shall be of ample section to safely withstand to attach gate slide to stem; provide with a means of locking it to lowering stem after it is installed. Pads for mounting wedging devices shall be machined and drilled. A groove shall be cut in each pad to receive the mounting tongue on side wedge.
3. Seating Faces: All seating faces shall be machined bronze.
4. Wedging Devices: Provide each gate with sufficient adjustable wedging devices designed to wedge seating faces of slide against those on frame when gate is fully closed, to obtain a practical degree of water-tightness. Provide with positive means of locking. Individual parts of each wedging device shall be removable and replaceable without complete disassembly of gate or guide. Equip all gates with side wedging devices for seating head application and side, top and bottom wedges for unseating applications.

B. Fabricated Gates

1. Gate Frame: Provide a flat structural steel frame for wall mounting. The frame material shall be as indicated on the plans or where nothing is indicated, shall be 304 stainless steel, be wall mounted and have a minimum thickness of 1/4". The frame shall be drilled for anchor bolts and provide a smooth sliding surface and structural retention of the gate/disc. The indicated size of gate shall reference the size of opening with the frame mounted to allow the gate/disc to bridge and isolate the opening.
2. Gate/Disc: The gate/disc shall be fabricated as a one piece flat plate with stiffing ribs for reinforcement to withstand twice the calculated hydrostatic head conditions. The gate shall be of the same designated material as the frame with sealing material between the gate and frame providing hydrostatic isolation of the designated wall opening.
3. Fabricated Gates shall be as manufactured by Fontaine, Whipps or pre-approved equivalent.

C. Slide Gates

1. Furnish and install self-contained fabricated 304 stainless steel slide gates as indicated on the plans and as manufactured by Fontaine, Whipps or pre-approved equivalent.
2. The disc shall be a flat plate suitably reinforced to withstand the required head conditions. The frame shall consist of guide rails along the sides and extending above the wall to support a structural yoke. The frame length and seal gasket will be such to allow for an invert or bottom seal across a channel or wall openings isolating the operational cross-section. Alternatively, the gate may act as an adjustable weir with the gate retracting downward exposing more channel or wall opening cross-sectional area. The gate will be operated by a stainless steel rising stem attached to the disc and either passing through a right-angle gear operator with attached vertical operating hand-wheel. The gear operator shall have grease fittings for lubrication.

- D. Fasteners and Hardware: All anchor bolts, assembly bolts, screws, nuts, etc., shall be ample section to safely withstand forces created by operation of gate while subjected to maximum head. Provide quantity and size of fasteners recommended by manufacturer. All fasteners, anchor bolts and other connecting hardware shall be 304 stainless steel.

- E. Stem: Gates shall have a rising stem, unless otherwise noted. Stems/operating shafts shall be manufactured and machine threaded from 304 stainless steel from round bar stock. Stem diameter shall be adequate to safely withstand forces created during gate operation under unbalanced heads, with proper thread length for complete opening or operation of the gate. Gates shall operate with clockwise rotation of the rising stem. The stem shall be designed to transmit in compression a minimum of two times the rated output of the floor stand or bench stand with a 40-pound effort on the crank or hand-wheel. Full height, clear, polycarbonate covers are to be provided and be of sufficient structural strength and UV resistance to maintain their shape and integrity through the service life of the associated component.

- F. Floor Stands: Floor stands or bench stands shall be cast iron and operate the gates under the specified operating head with not greater than a 40-pound pull on the crank or hand-wheel. Floor stands shall be top of wall mounted approximately 36 inches high. Where stands are not mounted to the top of wall provide gusseted base mounting plates affixed to both top and side face of the wall.

- G. Painting of Floor Stands: Clean surfaces by sandblasting to base metal. Surfaces shall be dry and free of grease before painting. Provide protective coating in accordance with Division 9 - Finishes.

2.02 VALVES

A. Gate Valves:

1. Gate valves 1-3/4" and smaller: Provide 125-pound standard (200-pound WOG) bronze, double disc, rising stem gate valves with union bonnet and threaded connections, Stockham B-106 or preapproved equivalent.
2. Gate valves 2" and larger: Provide flanged ANSI Class 125, right hand close valves in accordance with AWWA C-500-61, Standard for Gate Valve for Ordinary Water Works Service, Mueller A-2480-6 or preapproved equivalent.

- B. Plug Valves: Valves shall be non-lubricated, full port plug valves with cast body semi-steel resilient plug face and have a welded nickel seat. Bushing and bearings are to be stainless steel with an adjustable stem packing gland. Above ground valves ten inches and larger

shall be worm gear operated. Equip buried valves with extended waterproof gear operators. Provide DeZurik, Pratt plug valves or preapproved equivalent.

C. Check Valves:

1. Hydraulic (Wastewater Service): Provide cast iron body, rubber faced disc, external weight and lever air cushion dispensing chamber, non-corrosive shaft rubber boot cover, ANSI Class 125 flanged end valves as manufactured by Golden Anderson, Pratt or preapproved equivalent.
2. Air Check Valves: Provide Technocheck or preapproved equivalent. Valves are to have an aluminum/bronze body and plate with Viton-A seals with 316 stainless steel spring and retaining pin.

D. Butterfly Air Control Valves: Provide high temperature (350°) air tight resilient seat either wafer or flanged body butterfly valves as manufactured by DeZurik, Pratt or preapproved equivalent. Lever operated 4-inch through 10-inch; enclosed worm gear operated 12-inch and larger.

E. Telescoping Valves: Supply telescoping valve assemblies of the size and travel length as indicated on the plans, consisting of a 304 stainless steel rack and pinion crank operator with locking device or a 304 stainless steel round rising operating stem. Operation shall be via an off-set or center mounted, fixed floor stand (see 2.01 Gates). The stainless steel stem or shaft shall be connected to either a seamless brass or 304 stainless steel valve/slip tube of minimum 1/8-inch wall thickness. The valve tube will have two V-notch weirs cut into the top at opposite sides, have a flanged tube seal, and have a minimum of 6" clearance between the tube and the bottom of the connecting bail. Telescoping valves to be as manufactured by Waterman, Trumbull, JMS, or preapproved equivalent.

F. Air and Vacuum Release Valves: Provide a sewage air and vacuum release valve as indicated on the plans. The valve shall have a two (2) inch inlet with a two (2) inch shut-off valve. Other accessories will include one (1) inch blow-off valve and a flexible back flushing hose with a quick disconnect coupling and a 1/2-inch shut-off valve. The air and vacuum valve shall be manufactured by Apco, Val-Matic, Golden Anderson, or preapproved equivalent.

G. Ball Valves: Provide full port bronze ball valves as manufactured by Stockham, Watts or pre-approved equivalent. Valves are to have glass reinforced durafill seats, hard chrome plated brass ball and bottom loaded pressure retaining stem. The valves are to have a minimum WOG pressure rating of 400 psi and a minimum operating temperature of 230 degrees C.

H. Backflow Preventer: Provide one anti-syphon, reduced pressure principle, backflow preventer as manufactured by Watts (Series 909), Febco (Series 825Y) or pre-approved equivalent. The unit is to have a bronze body with multiple rubber check valves. The check valve seats, shafts and flange bolts are to be 316 stainless steel. The relief valve is to be rubber with 316 stainless steel seats. The minimum valve operating conditions are to be 175 psi and 95 degrees C.

I. Knife Gate Valve: Provide a 316 stainless steel wafer bodied knife gate valve, as manufactured by DeZurik, Pratt or pre-approved equivalent. The valve is to have a beveled edge, 316 stainless steel gate with a 316 stainless steel stem and raised 316 stainless steel face seat. Provide a hand wheel actuator unless noted otherwise.

J. Electric Actuators: Provide electric valve and gate actuators as manufactured by EIM, Limitorque, Rotork, specified valve manufacturer's integral unit or pre-approved equivalent.

The actuator shall open and close valves within 30 seconds without strain, binding or motor overload. The motor should be of the extended duty type and shall operate on either 480V/3p or 120V/1p 60 HZ, as noted. Where 480V feeder power is supplied to the unit, provide all internal operating power, control power when not indicated otherwise, for a completely self-contained operating unit (both manual and automatic function). The enclosure shall be NEMA 4 and have a back shaft operating hand-wheel for manual operation. The unit shall have a minimum of two adjustable open and close, SPDT limit switches; additional switches are to be provided as required for proper unit function. When operating as a function of an analog or dc input signal the unit shall have infinite position settings proportional to the input signal. Also, the unit shall be potted for a like output signal indicating valve position.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all items to be embedded in concrete by template when structure is poured. Oil and grease moving parts. Install all gates, valves, and accessories in accordance with manufacturer's printed instructions, in such manner as to insure a watertight fit, complete and ready for operation. Operate gates and valves through one cycle, i.e., "open, close, open" or "close, open, close" to assure they have been properly lubricated and adjusted. All gates shall be installed to open upward unless otherwise noted.

END OF SECTION

43 41 13.33 - GROUND STORAGE TANK

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

NOTE: "Tank" & "Reservoir" used interchangeably

1.1 SECTION INCLUDES

- A. Design Criteria for liquid storage reservoir.
- B. Structural steel components for the liquid storage reservoir.
- C. Accessories for liquid storage reservoir.
- D. Coating materials and procedures for liquid storage reservoir.
- E. Erection materials and procedures for liquid storage reservoir.

1.2 RELATED SECTIONS

- A. Section 03300 Cast in Place Concrete
- B. Section 15051 Specialized Mechanical Materials and Methods for Process Piping
- C. Section 15150 Equipment Installation
- D. Section 09900 Coatings

1.3 REFERENCES

- A. AWWA D 103 Standards of the American Water Works Association
- B. ANSI
- C. ASTM
- D. SSPC
- E. NSF Additives Standard No. 61
- F. OSHA
- G. NFPA

1.4 SUBMITTALS

- A. Shop drawings covering tank, anchorage (if required), accessories, appurtenances and coatings shall be submitted.

1.5 QUALIFICATION/EXPERIENCE

- A. The tank manufacturer shall be a specialist in the design, fabrication with a minimum of (10) years documented experience and erection of factory coated bolted steel tanks. The manufacturer shall be a 3rd party quality certified, having an active ISO-9001 and API-Q1 registration.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All plates, supports, members, and miscellaneous parts shall be packaged for shipment in such a manner to prevent abrasion or scratching of the finish coating.

1.7 WARRANTY

- A. The tank manufacturer shall warrant the tank against any defects in workmanship and materials for a period of one (1) year from date of shipment. In the event a defect should appear, it shall be reported in writing to the manufacturer during the warranty period.

PART 2 - PRODUCTS

2.1 WATER STORAGE TANK

A. Acceptable Manufacturers

1. CST Industries, Inc., Kansas City, MO
2. Superior Tank Company Inc, Rosenberg TX
3. Pre-Approved Equal

B. Bolted Tank Design Criteria

1. Type of Liquid - Water
2. Specific Gravity –
3. Seismic Zone – IBC 2006 to 2015
4. Wind – 150 MPH
5. Deck Live Load – 25 psf

C. Bolted Tank Structure

1. The materials, design, fabrication, and erection of the bolted steel tank shall conform to the Principles of Standard Specification 12B of the American Petroleum Institute, or to the manufacturer's specifications which are derived from engineering principles, industry experiences, and the aforementioned standards and specifications.

*****Vertical tank seams shall be staggered. Straight seam 4-corner joints are not acceptable.***

2. Standard shell height and diameter meeting requirements for the selected capacity.
3. Storage Capacity: 250,000 Gallons (Nominal)
4. Tank Diameter: 44'-6 ³/₄"
5. Tank Height: 24'-1 ¹/₂"
6. Steel
 - a. Hot Rolled Steel Sheets and Plates
 - 1) Hot Rolled Steel Sheets and Plates shall meet or exceed the requirements of ASTM A1011 Grade 40 with a minimum yield strength of 40,000 psi.
 - 2) Minimum thickness shall be 12 gauge (0.0972 in.)
 - b. Structural Shapes
 - 1) Structural shapes shall conform to ASTM A36 or ASTM A992.
 - 2) Other grades of carbon steel that meet or exceed these standards may be utilized.
7. Bolts/Nuts/Washers
 - a. Galvanized Bolts
 - 1) Galvanized bolts, nuts, washers used in tank joints shall be minimum 1/2" diameter and shall meet or exceed the requirements of API 12B or AWWA D103.

GROUND STORAGE TANK

- b. Encapsulated Bolts
 - 1) Encapsulated bolt heads shall be used for additional corrosion protection.
 - c. Anchor Bolts
 - 1) Anchor bolts shall meet or exceed the requirements of ASTM A36 or ASTM A325.
 - d. Other Bolts
 - 1) Other bolts shall meet or exceed the requirements of ASTM A307 or ASTM A325.
8. Gaskets
- a. All bolted connections shall incorporate an EPDM prefabricated gasket with a minimum width of 1-3/4".
 - b. A single piece double punched gasket shall be used at vertical seams which require two vertical rows of punching.
 - c. Field caulking will be allowed only when joining a discontinuous gasket section and at certain joint connections.
 - d. Neoprene backed steel washers shall be provided at all bolts in contact with the stored liquid.
 - e. Sealants may not be used in place of gasket material for vertical or horizontal seams.

D. Coating

- 1. All metal plates, supports, members, and miscellaneous parts, except bolts, certain accessories, and appurtenances, shall be factory coated in accordance with the provisions of these specifications.
- 2. Field coating, except for touch-up will not be permitted.
- 3. Surface Preparation
 - a. Tank parts are to be thoroughly washed (Alkaline at 130 deg F) and rinsed to remove grease, oil and foreign matter.
 - b. Parts are then to be immediately oven dried.
 - c. Parts are to be grit-blasted to SSPC-SP 10 (Near-White Blast Cleaning) to 1-2 mils profile.
 - d. All parts must be coated by Automated Powder Applicators on both sides within 15 minutes after blasting, and no further processing other than coating application shall be done.
- 4. Interior Coating
 - a. Thermally cured modified epoxy powder, Trico-Bond EP by CST Storage (includes underside of the steel floor)
 - b. First coat is to be a powder application of NSF approved modified epoxy Trico-Bond EP, 7.0 mils average dry film thickness.
 - c. Coating system to have 7.0 mils average dry film thickness.
- 5. Exterior Coating
 - a. Thermally cured modified epoxy powder, Trico-Bond EP and acrylic polyurethane by CST Storage
 - b. First coat is to be a powder application of modified epoxy Trico-Bond EP, 3.0 mils average dry film thickness.
 - c. Second coat of acrylic polyurethane, 1.5 mil average dry film thickness.
 - d. Coating system to have 4.5 mils average dry film thickness.
- 6. Curing
 - a. Baking ovens to be used after each coat

- b. Initial curing shall take place after powder is applied. A combination of IR boosters and convection ovens will be used to heat parts to approximately 300 deg. F to gel the powder (partial cross-linking).
 - c. Final curing shall take place after top coat is applied. A combination of IR boosters and convection ovens will be used to heat parts to approximately 350 deg. F for 5-6 minutes to finish curing powder and topcoat.
 - 7. Inspection
 - a. MEK rub test to verify proper curing of coating.
 - b. Wet sponge test to check for holidays.
 - c. Mill thickness test for uniform epoxy coverage.
 - 8. Preparation for Transport
 - a. Material to be marked or tagged with part number for ease of field assembly.
 - b. Tank materials to be placed in racks or on pallets to facilitate transportation to jobsite.
 - c. Touch-up paint with instructions for application by erection personnel.
- E. Appurtenances
- 1. The contractor shall furnish and install the appurtenances as shown in the contract drawings and as specified below. Unless otherwise noted, standard appurtenances shall be as follows:
 - 2. Hatch
 - a. The tank roof hatch shall have a curbed, upward opening 24" square.
 - b. The curb shall extend at least 4" above the roof surface.
 - c. The hatch cover shall be hinged and have provisions for locking.
 - d. The hatch cover lip shall extend 2" below the top of the 4" curb.
 - 3. Inlet and Outlet Connections
 - a. Inlet, outlet, and overflow connections shall conform to the sizes and locations specified on the contract drawings.
 - 4. Vent
 - a. A mushroom screened vent shall be furnished above maximum water level of sufficient size to accommodate normal inlet and outlet flow.
 - b. The overflow pipe shall not be considered to be a tank vent.
 - c. The vent shall be galvanized steel and so designed and constructed as to prevent the entrance of birds, animals, or insects.
 - 5. Flush Cleanout Door/Shell Manway (Optional)
 - a. The flush cleanout door shall measure 24" x 46" and be located as shown on the contract drawings.
 - b. The shell manway shall have a 24" opening complete with hinged cover, and shall be located as shown on the contract drawings. (Optional)
 - 6. Outside Ladder
 - a. An outside galvanized ladder, meeting OSHA specifications, shall be furnished at the location shown on the contract drawings.
 - 7. Guardrail and Toeboards
 - a. Galvanized guardrail with toeboard shall be furnished at the location(s) shown on the contract drawings.

PART 3 - EXECUTION

3.1 Installation

A. Erection

1. Field erection of factory coated bolted steel tanks shall be in strict accordance with the tank manufacturers recommendations.
2. Particular care shall be exercised in handling and bolting of the tank plates, supports, and members to avoid abrasion or scratching of the coating.
3. Touch-up coating shall be done in accordance with the tank manufacturer's recommendations where and as directed.

B. Testing

1. Following completion of erection and cleaning of the tank, the tank shall be tested for liquid tightness by filling the tank to its overflow elevation.
2. Any leaks disclosed by this test shall be corrected by the erection contractor in accordance with the tank manufacturer's recommendations.
3. The Owner shall provide clean water free of charge at the time of erection completion, for hydrostatically testing the tank.
4. Filling and emptying the tank shall be the responsibility of the Contractor.

END OF SECTION 43 41 13.33